The Effect of Supplementation During Wintering of Calves on Subsequent Feed Lot Performance, Slaughter and Carcass Characteristics

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I. INTRODUCTION

The real value of slaughter cattle is determined by the potential carcass grade as well as by the weight of the cattle and the price per pound offered. Lower grading slaughter cattle are worth less per pound. Therefore, information that might aid the feed lot operator in feeding slaughter cattle into a certain grade without loss in rate of gain and efficiency of feed conversion would be of economic value to Florida's cattle industry.

During the past few years, workers of the Florida Agricultural Experiment Station have observed a rather high incidence of carcasses which even though well finished externally and excessively finished over the kidney knob failed to grade up to expectations due to a lack of marbling. Thus, it appears that lack of marbling, not a lack of finish or fatness in general, is a limiting factor in the gradability of some Florida fed slaughter cattle.

Pfander (1955) wintered yearling steers on four planes of nutrition for 127 days. The animals were then placed on fescue--ladino pasture for 103 days and then finished to the Choice grade in the feed lot. The steers on the low plane of nutrition during wintering required a longer feeding period to reach the Choice slaughter grade. Pfander also reported that carcasses from cattle on submaintenance winter nutrition had a larger percentage of fat deposited on the outside of the carcass and between muscles than steers on the higher nutritional levels. Steers from the higher wintering levels had significantly more marbling. The low plane carcasses graded lower and showed greater grade variability but were not deficient in conformation.

Pfander's work thus shows the effect of a low plane of nutrition during wintering on ability of cattle to marble in the feed lot even when opportunity for the effect to exert itself was maximized by the summer grazing period. It is therefore feasible that low planes of nutrition during the wintering of Florida cattle may be at least in part responsible for a lack of marbling response during feeding. This is possible since most of Florida has a seasonal shortage of good grazing and since many cattlemen winter stock as cheaply as possible either on pasture alone or on pasture plus small supplementations, often resulting in loss of weight during the wintering period or at most slight gains. This period of no gain in weight in young cattle is believed to result in loss of at least part of the potentiality for rapid growth, of efficiency of feed utilization and of grade potentiality. Therefore, it is important to the cattle producer to know whether or not wintering gains will affect subsequent performance of cattle in feed lot and the quality of beef produced as measured by marbling and/or carcass grade.

Objectives

The primary objective of this study was to determine the effect of level of nutrition during wintering on marbling and other fat deposition following finishing in feed lot. A further purpose was to determine the effect of winter supplementation on feed lot performance as indicated by average daily gain and feed efficiency.

Treatment effects on slaughter characteristics such as per cent gastro-intestinal tract, per cent of caul and ruffle fat and per cent of fill, all of which directly affect dressing percentage, were studied.

The important palatability traits of tenderness and juiciness of steaks and roasts were evaluated to determine the effects of the different winter nutritional levels.

Another facet of this trial was a study of the proportion of fat, lean, and bone comprising a carcass as measured by the percentage of these constituents in the 9-10-11 rib cut. The rib eye area, which is a measure for meatiness of the total carcass was studied to determine if the treatment had any influence on the amount of lean meat in the carcasses.

A further objective of this study was to determine if a useful relationship between cannon bone weights and/or measurements and meatiness of the carcass could be found.

II. REVIEW OF LITERATURE

Effect of Winter Nutrition on Feedlot Performance

Winchester and Howe (1955) used identical twins to study the effects of delayed growth induced by energy restriction. Energy was restricted to 75, 62, and 50 per cent of the energy supplied by a liberal ration. Gains ranged from 2- 1/4 pounds per day in the liberally fed control animals to a loss of weight in the most severely restricted group. It was observed that after six months of restriction, rate of gain response to increased rations equaled or exceeded that of the controls; further, the gains were more efficient.

In a later study, Winchester et al. (1956) restristed energy to submaintenance, maintenance, and 75 per cent of a liberal ration. Following the restriction period, feed required to produse an animal of given size was not increased even when the growth of young calves was interrupted for three to four months.

Winchester et al. (1957) reported that a period of nutritional restriction had little influence upon over-all feed utilization. Experimental animals converted feed more economically but required more time to attain market weight.

Calves to be finished on drylot in the spring and summer as yearlings have better performances when fed two to four pounds of concentrates per day during wintering to maintain an improving condition according to Story and Hazle (1957). Steers wintered on roughage without grain had the highest average daily gains in feed lot and required less feed; however, the carcass yield and grade was higher with the steers supplemented during wintering.

Effect of Winter Nutrition on Slaughter and Carcass Characteristics

The degree of fatness of a carcass largely determines the proportions of lean, fat, and bone of a carcass. Callow (1947) further reports that a fall in muscular tissue is closely correlated with the rise in fatty tissue and that chemical fat in muscle tissue rises as per cent of fatty tissue in the carcass increases.

Major differences in carcass composition are due to differences in fat content; within reasonable limits, the fatter the animal, the higher will be dressing percentage, carcass grade, and percentage of fat in the carcass and the lower will be the per cent of moisture, protein, lean, and bone, according to Moulton *et al*. (1922b), Chatfield (1926), Branaman *et al*. (1936), Hirzel (1939), Foster (1933), Hankins *et al*. (1940) and Callow (1944, 1947, 1949).

Callow (1944) found a correlation coefficient of .93 between the weight of carcass fat and dressing percentage. In a later paper, Callow (1949) indicated that rapid fattening may be expected to produce carcasses with a slightly smaller percentage of muscular tissue and a slightly greater percentage of bone than is the case with carcasses from animals fattened more slowly when carcass fatness is held constant.

With increasing age and degree of fatness, an increase in offal fat and a decrease in per cent of intestine and stomach results according to Moulton *et al*. (1922a).

Physical composition of the 9-10-11 rib cut has been used as an estimate of the composition of the dressed carcass. Hankins et al. (1943) reported correlation coefficients of .93, .90, and .80 between the fat, lean, and bone of the rib cut and the same constituents of the carcass respectively. Hopper (1944) concluded that the 9-10-11 rib cut was quite a reliable indicator of the fat, lean, and bone of the carcass. Hankins and Howe (1946) corroborated the findings of the earlier workers and further indicated that the separable fat of the 9-10-11 rib cut could be used for estimating the ether extract content of the edible portion of the dressed carcass. The separable lean of the rib cut had a correlation coefficient of .77 with the protein content of the dressed carcass; a correlation coefficient of .81 was found between protein content of the rib cut and the protein content of the dressed carcass.

Butler et al. (1955) studied the accuracy of cut out obtained by cutting both sides of a carcass, concluding that data obtained from one side is accurate enough for most purposes. Cahill et al. (1955) found a direct relationship between the edible portion of a carcass and area of L. dorsi muscle at the twelfth rib with a correlation coefficient of .85.

Winchester and Howe (1955) used identical twins to study the effect of reduced energy intake for six months on dressing percentages and quality of beef following liberal feeding to a weight of 1,000 pounds. Carcass grades of controls and retarded twins were, with a single exception, the same. Bone constituted a similar percentage of the carcasses of twins. However, in five of the six pairs, the eye of the 9-10-11 rib cut was fatter in the animal that had been on the restricted ration. In four of the six pairs, the remainder of edible portion of the 9-10-11 rib cut was fatter. Only insignificant differences in dressing per cent were found. Winchester and Ellis (1956) and Winchester et al. (1957) in similar studies, essentially substantiated the earlier work.

Pfander (1955) wintered steers at different nutritional levels to obtain group average daily gains of -0.04 pound, 1.0 pound and 1.5 pounds, followed by 103 days on pasture and finishing to the Choice grade in feed lot. Data from the physical separation of the 9-10-11 rib cut showed the third highest plane of nutrition group had 18.4 per cent less separable fat and 11.8 per cent more separable lean. Chemical analysis showed 65.5 per cent more crude fat in the rib eye. Pfander reported that carcasses from cattle on submaintenance winter nutrition had a larger percentage of fat deposited on the outside of the carcass and between muscles than steers on higher nutritional levels. Steers from the higher wintering levels had significantly more marbling and required less time to reach market grade. Carcasses from animals on low winter nutrition graded lower and showed greater grade variability.

The Relationship of Fatness With Tenderness and Juiciness

Hiner et al. (1955) defines tenderness in beef as a function of many interrelated factors, such as breeding, feeding, management, age, period of aging the raw meat, size of fibers, method of cooking, and probably many others.

The belief that juiciness and tenderness can be improved by fattening an animal has been expressed by Armsby (1908, 1917), Hall (1910), Bull (1916) and Helzer (1929). However, proving that tenderness and juiciness is increased to a marked degree by fattening has been difficult. Mackintosh et al. (1936) stated that there was a positive relationship between tenderness and amount of fat in the eye muscle. Cover (1937) found a low degree of association among fatness, tenderness and carcass grade values.

Cover et al. (1956) indicated that tenderness scores were more closely related to ether extract of the rib eye than other measures of fatness, the relationship although significant, indicated that ether extract of the rib eye accounted for only ten per cent of the variation in tenderness of loin steaks. In a later experiment, using 203 yearling steers, Cover et al. (1958), found a correlation coefficient of -.226 between carcass grade and tenderness. A slight trend toward greater tenderness was noted with higher degrees of marbling as measured by ether extract. Carcasses within each grade differed widely in tenderness.

Hankins and Ellis (1939) reported a correlation coefficient of -.108 between ether extract of the rib eye and shear force value of the 9-10-11 rib cut roasted rare. A correlation coefficient of .15 between subjective evaluation of marbling and tenderness was reported by Hiner (1956). Carcass grade gave a slight indication of tenderness with a correlation coefficient of .20; a correlation coefficient of .34 was found between grade and juiciness.

Doty (1956), summarizing a three year study which involved 153 graded beef carcasses, indicated that juiciness scores of cooked rib eye were highly correlated with carcass fat, intramuscular fat and marbling ratings. Barbella et al. (1939) and Wanderstock and Miller

(1948) concur in reporting that fatness is more closely associated with juiciness of roasted 9-10-11 rib cuts than with tenderness of the same cut.

An insignificant relationship between tenderness and carcass fatness was found by Branaman et al. (1936); Hostetler et al. (1936) reported that some tender carcasses had lower percentage of ether extract in the eye muscle. Satorius and Child (1938) and Hiner and Hankins (1950) reported that tenderness was not associated with carcass grade to any appreciable degree. Ramsbottom et al. (1945) found little relationship between marbling and the shear force of cooked muscle.

In a study involving 452 animals of mixed breeding, varying age, sex, and treatment, Palmer et al. (1958) reported correlation coefficients of .277 between grade and tenderness, .328 between marbling and tenderness and .276 between ether extract of the rib eye and tenderness of the broiled loin steaks.

Winchester and Howe (1955), Winchester and Ellis (1956), and Winchester et al. (1957) reported little difference in tenderness and juiciness between roasts from steers that had been nutritionally retarded and roasts from their liberally fed twins.

Muscle--Bone Relationships in Beef

Increased emphasis recently has been placed on the amount of muscling or meatiness of beef carcasses. This has led to a search for an objective index of carcass muscling. The cannon bones have been studied for their possible relationship with amount of muscling. Muscles are attached to bones and their chief purpose is to move the bones; it seems logical that their size and shape is associated with the size and shape of bones. Considerable work is presently underway in the field of muscle-bone relationships but very little has been published on the subject.

Hammond (1932) stated that from the meat production point of view, one of the most important considerations is the relationship between length and thickness of the bones. Improvement in the meat producing breeds has consisted largely in increasing the thickness growth of bones relative to length, the reduction in the ratio being correlated with a greater thickness in the associated muscles. After dissection of large numbers of swine, McMeekan (1940) concluded that the length growth of a muscle naturally follows that of the bone around which it lies and as in bones, thickness growth of muscle develops later than length growth and seems also to be linked with thickness growth in the bone. Concerning the weight of cannon bone-muscle ratio, McMeekan (1956) stated, "So strong is this relationship that the weight of muscle could be determined within one per cent if the weight of the cannon bones are known." He also stated "that the finer boned animals have a smaller amount of lean tissue and a larger amount of fat than the heavier boned animals on a percentile basis."

Wythe et al. (1958) reported significant correlations of .645 between trimmed metacarpus weight and rib eye area and .680 between trimmed metatarsus weight and rib eye area. They further reported correlations between loin eye area and length of metacarpus and metatarsus of .537 and .483, both of which were significant.

Orme et al. (1958) reported that simple correlation coefficients of rib eye area with the weights and different measurements of the cannon bones were not statistically significant.

III. EXPERIMENTAL PROCEDURE

Allotment and Wintering

Forty-four weanling heifers of mixed breeding but predominantly Brahman and Shorthorn crosses were grouped into four lots by approximate weight and breeding. Wintering and feed lot phases of this study were conducted at the Range Cattle Station, Ona.

Each lot of eleven heifers was placed on five acres of Bahia grass pasture in the latter part of October, 1957, for the wintering phase of this trial. The treatment was to regulate concentrate supplementation during the 119 day winter period to obtain a distinctly different rate of gain between the four lots as shown in Table 1. Supplementation for Lot I was restricted to approximately one-half of the National Research Council recommendations for wintering weanling calves so that gains would be submaintenance to maintenance. Lot 2 was to gain one-quarter to one-half pound daily, Lot 3 to gain from three-quarters to one pound daily and Lot 4 to gain one to one and one-half pounds daily.

The wintering supplement consisted of cottonseed meal, 41 per cent and citrus pulp, adjusted periodically as to proportion and amount fed to control rate of gain. Roughage came exclusively from the pasture except for the last two weeks of the wintering period when one-half pound of cottonseed hulls per animal daily were included in the feed. A complete mineral mix was kept before the animals at all times, the composition of which is shown in Table 2. Weights were recorded once

TABLE 1

EXPERIMENTAL DESIGN

Wintering Phase (119 Days)				Feed Lot (140 Days)
Lot	No. Animals	Initial Avg. Wt.	Control of Daily Gain Lbs.	
1	11	400	submaint.	self-fed fattening ration
2	11	380	0.25-0.50	self-fed fattening ration
3	11	388	0.75-1.00	self-fed fattening ration
4	11	405	1.00-1.50	self-fed fattening ration

TABLE 2

COMPLETE MINERAL MIX COMPOSITION [a]

Ingredient	Percentage
Common Salt	31.2
Deflourinated Phosphate	28.0
Steamed Bonemeal	28.0
Red Oxide of Iron	3.1
Copper Sulfate	0.63
Cobalt Chloride	0.04
Cane Molasses	7.00
Cottonseed Meal (41 per cent)	2.00

[a] Mineral mixture used at the Range Cattle Station, Ona.

a month throughout the wintering phase of the trial which ended February 18, 1958, completing a total of 119 days. The animals were then placed in feed lot for a fattening period.

Feed Lot Ration

All treatment groups were weighed off the wintering trial February 19, 1958, and placed in feed lot. Each heifer at this time was graded on a feeder basis by two experienced graders.

The feed lot period extended for 140 days and the ration was the same for all lots, self-fed with complete mineral mix available at all times. The feed lot ration is shown in Table 3. Roughage was supplied in the form of coarsely chopped pangola grass hay--1.44 to 1.49 pounds per head per day.

The protein content of the ration was adjusted twice during the feed lot period to accomodate for increased age of the animals. On the eleventh week of feeding, the cottonseed meal was lowered to twenty parts and the citrus pulp was raised to 41.5 parts. Again on the fifteenth week, the cottonseed meal was further reduced to 18 parts and the citrus pulp increased to 43.5 parts. All other components of the ration remained constant. Feed consumption and weight gain records were kept on each lot.

Slaughter Procedure

The heifers were weighed out of feed lot and trucked 187 miles from the Range Cattle Station to Gainesville for slaughter. The heifers were weighed off the truck and penned overnight with free access to water. Weights were taken the following morning prior to slaughter.

TABLE 3

FEED LOT RATION COMPOSITION

Ingredient	Percentage
Citrus Pulp	39.0
Cottonseed Meal (41 per cent)	22.5
Cottonseed Hulls	22.5
Yellow Cornmeal	10.0
Alfalfa Pellets	5.0
Complete Mineral	1.0

Routine slaughter procedure was employed; head, heart, liver, tail, pluck, feet, and hide weights were recorded. The gastro-intestinal tract was stripped of caul and ruffle fat, the spleen and reproductive organs removed and weighed. The gastro-intestinal tract was emptied and weight of the empty tract recorded. Warm carcass weights were taken, the carcasses washed, shrouded, and rolled into a cooler with a temperature of 34° F.

Carcass Sampling

Following a forty-eight hour chill period, chilled carcass weights were taken; carcass measurements made according to the method described by Naumann (1952). Carcasses were graded according to Official United States Standards for Grades of Carcass Beef (1956) to the nearest one-third of a grade by a Federal Meat Grader. Grade as to conformation, inside quality and outside finish was recorded; carcass maturity was determined. The left sides were ribbed between the eleventh and twelfth ribs and marbling scores obtained. The prime rib and short loin of both sides were removed as recommended by Wellington (1953).

Left Side

The 6-7-8 and the 9-10-11 rib cuts were made, the former for palability studies and the latter for physical separation and chemical analysis. The twelfth rib remained on the short loin for chemical analysis of the L. dorsi. All cuts were wrapped and frozen at the end of the forty-eight hour chill period.

Right Side

The prime rib and short loin were removed intact and aged at 38° F. for five more days. The 6-7-8 rib cut and short loin were separated from the 9-10-11 rib cut, wrapped and frozen.

Organoleptic Panel

A three-fourths inch cut of the twelfth rib of the left side was removed from the frozen short loin and the *L. dorsi* removed, trimmed of external fat and connective tissue and put through a food grinder with a plate of one-eighth inch holes, three times to assure homogeneity. Ground samples were wrapped in aluminum foil to minimize moisture loss and refrozen. The food grinder was washed and dried thoroughly between each sample.

Two one-inch steaks were removed perpendicular to the backbone from the anterior end of the frozen short loin. One steak included the thirteenth rib, the second steak was the first club steak. Rib eye tracings were taken of the *L. dorsi* between the twelfth and thirteenth rib on both left and right sides. The area of the eye muscle was measured by a compensating polar planimeter. Depth of fat over the rib eye was measured to the nearest one-tenth of an inch in three places perpendicular to the long axis of the eye muscle; depth values were averaged. The steaks were cut the day before testing by panel and allowed to defrost overnight in a 36° F. cooler.

Steaks were broiled in a pre-heated oven for approximately nine minutes on one side and eight minutes on the reverse side to medium doneness, removed from the broiler and allowed to cool to room temperature. Three one-half inch cores were taken from the *L. dorsi*, one at the top, one in the middle and one from the lower third of the muscle. The cores were tested on the Warner-Bratzler shear apparatus, with each core providing two shear readings for a total of six values for each steak. The remaining portion of the L. dorsi was divided among the four panel members with each panel member receiving the same area of the steak at each testing. The taste panel determined tenderness on a scale ranging from one to six with one being inedible, two objectionable but edible, three below average but not decidedly objectionable, four average, five above average and six as superior in tenderness.

The standing rib roasts were removed from the freezer and defrosted for forty-eight hours in a 36° F. cooler. Twelve roasts were tested daily, six unaged and six aged roasts. All roasts under six pounds were cooked in a 350° F. oven to an internal temperature of 160° F. Roasts over six pounds were cooked at 300° F. to the same internal temperature. The L. dorsi muscle was taken out and two one-inch slices from the blade end were allowed to cool to room temperature before cores were taken for shear readings. The taste panel consisted of the same four members that tested the steaks; cores for shear test and taste panel samples were prepared in the same manner as for steaks.

Taste panel evaluations of juiciness were determined for steaks and roasts using the same scale as for tenderness.

Physical Separation of 9-10-11 Rib Cut

The 9-10-11 rib cut of the left side was weighed and then separated into fat, lean, bone, and connective tissue. Each component was weighed. The separable fat and lean components were then ground together in a food grinder three times and refrozen for chemical analysis.

Chemical Analysis

Moisture determinations were made on the ground *L. dorsi* sample and ground fat-lean mixture of the 9-10-11 rib cut. Ether extracts were run on the dried *L. dorsi* samples and the fat and lean mixture of the 9-10-11 rib cut. Protein determinations were calculated on a wet basis. All chemical analysis were made according to AOAC methods (1955).

Cannon Bone Measurements

The metatarsus and metacarpus of each animal were cleaned of all flesh and tissue and weighed to the nearest gram. Length measurements were taken to the nearest centimeter and width and depth measurements were taken in the center of the bone shaft with Vernier calipers. A six inch span was used and breaking strength determined by use of a Riehle breaking machine.

IV. STATISTICAL ANALYSIS

The statistical analysis of data in this trial was made by the University of Florida Statistical Laboratory using the method described by Cohen (not dated) for analysis of variance and for multiple regression analysis on the IBM 650 Computer. Means and standard deviations of the variables studied were provided by this method of analysis. A least squares analysis was employed to determine the effect of breed on marbling score, carcass grade and dressing per cent. Significance of statistical computations was determined according to Snedecor (1957).

Feed utilization, collected on a lot basis rather than on individual performance, was not subjected to statistical analysis. Data on slaughter by-products other than gastro-intestinal tract and contents and intestinal fat also were not tested statistically.

Statistical analysis results are presented in Tables 33 through Table 83.

V. RESULTS AND DISCUSSION

Analysis of Lot Performance

Wintering Supplementation and Average Daily Gain

Nutrients supplied by the wintering supplement as compared to National Research Council recommended allowances for wintering weanling calves are shown in Table 4. Winter supplementation was adjusted periodically to control rate of gain. Average daily gain and feed consumption data are presented in Table 5.

Lot 1, restricted to maintenance or less, was fed an average of 1.11 pounds of cottonseed meal (41 per cent) and 1.14 pounds of citrus pulp per animal per day. Lot 1 consumed 70 pounds of complete mineral during the wintering period. Average daily gain of Lot 1 during the 119 day wintering period was 0.06 pound.

The animals in Lot 2, intended to gain from one-quarter to one-half pound daily during wintering were supplemented with an average of 1.50 pounds of cottonseed meal (41 per cent) and 2.40 pounds of citrus pulp per animal per day. Lot 2 consumed 95 pounds of complete mineral during the wintering period. The average daily gain of animals in Lot 2 was 0.45 pound.

Lot 3 animals were to gain three-quarters to one pound daily during wintering and received an average of 1.70 pounds of cottonseed meal (41 per cent) and 4.80 pounds of citrus pulp per animal per day. This lot consumed 95 pounds of complete mineral. Lot 3 had an average

TABLE 4

A COMPARISON OF NATIONAL RESEARCH COUNCIL RECOMMENDED[a] DAILY NUTRIENT ALLOWANCES FOR WEANLING CALVES AND NUTRIENTS PROVIDED BY WINTER SUPPLEMENTATION

	N. R. C. Recommended Allowance		Supplied by Winter Supplement[b]	
Lot No.	DP (Lbs.)	TDN (Lbs.)	DP (Lbs.)	TDN (Lbs.)
1	0.7-0.8	6.0-7.0	0.41	1.65
2	0.7-0.8	6.0-7.0	0.59	2.85
3	0.7-0.8	6.0-7.0	0.73	4.76
4	0.7-0.8	6.0-7.0	0.78	5.52

[a] Recommended by the National Research Council for wintering weanling calves weighing 400-500 pounds to gain one pound per animal daily.

[b] All animals were wintered on Bahia grass pasture.

TABLE 5

THE EFFECT OF WINTER SUPPLEMENTATION ON PERFORMANCE OF WEANLING CALVES ON PASTURE

Lot No.	No. Calves	Avg. Initial Weight	No. Days Wintered	Avg. Final Weight	Avg. Da. Gain	Avg. Daily Feed Consumption* CSM (41 Per Cent) (Lbs.)	Avg. Daily Feed Consumption* Citrus Pulp (Lbs.)
1	11	400	119	408	0.06	1.11	1.14
2	11	380	119	434	0.45	1.50	2.40
3	11	388	119	486	0.82	1.70	4.80
4	11	405	119	538	1.11	1.80	5.60
Significance of difference					N. S.[a]		

*All lots received one-half pound of cottonseed hulls per animal per day for approximately the last two weeks of the wintering period.

[a] N. S. — difference not statistically significant.

daily gain of 0.82 pound.

The animals in Lot 4 were to gain from one to one and one-half pounds daily. Animals were supplemented with an average of 1.80 pounds of cottonseed meal (41 per cent) and 5.60 pounds of citrus pulp per animal per day. Lot 4 consumed 87 pounds of complete mineral. Lot 4 had an average daily gain of 1.11 pounds during the wintering period.

During the last two weeks of the wintering period, one-half pound of cottonseed hulls per animal per day was included in the supplementation of all lots to provide increased roughage.

Analysis of variance showed differences between lots in average daily gain during the 119 day wintering period to be insignificant; lack of statistical significance may be explained by the wide variation in individual weight gains within each lot.

The Effect of Winter Supplementation on Feed Lot Performance

The four groups of heifers were put in feed lot at the end of the wintering phase of the trial and self-fed the same fattening ration. Feed lot gains and feed conversion data are shown in Table 6.

Animals in Lot 1 averaged a daily gain of 2.08 pounds during the 140 day fattening period and required 939.8 pounds of feed per hundred pounds of gain. The heifers were fed an average of 1.49 pounds of coarsely chopped pangola grass hay per head daily. Lot 1 consumed 44.5 pounds of complete mineral during the feed lot period.

Lot 2 animals averaged a daily gain of 2.29 pounds during the feed lot period and required 977.5 pounds of feed per hundred pounds

TABLE 6

FEED LOT PERFORMANCE AND FEED EFFICIENCY

Lot No.	No. of Calves	Avg. Initial Weight	No. Days on Feed	Avg. Final Weight	Avg. Daily Gain	Feed Required* Per 100 Lb. Gain
1	11	408	140	698	2.08	939.8
2	11	434	140	753	2.29	977.5
3	11	486	140	745	1.85	1010.1
4	11	538	140	811	1.96	1004.5
Significance of difference					a	

*Animals in Lots 1 and 2 received in addition, 1.49 pounds of coarsely chopped pangola grass hay per animal daily. Animals in Lots 3 and 4 received in addition, 1.44 pounds of coarsely chopped pangola grass hay per animal daily.

[a] Difference significant at the five per cent level of probability.

of gain. Lot 2 animals consumed 47.5 pounds of complete mineral and were fed an average of 1.49 pounds of coarsely chopped pangola grass hay per animal daily.

The animals in Lot 3 had an average daily gain of 1.85 pounds during the feed lot period and required 1010.1 pounds of the fattening ration per hundred pounds of gain. Animals in this lot were fed an average of 1.44 pounds of coarsely chopped pangola grass hay per animal daily. Lot 3 animals consumed 70.5 pounds of complete mineral.

The animals in Lot 4 had an average daily gain of 1.96 pounds and required 1004.5 pounds of the fattening ration per hundred pounds of gain. Lot 4 was fed 1.44 pounds of coarsely chopped pangola grass hay per animal daily and consumed 67.0 pounds of complete mineral during the finishing period.

Average daily gains in feed lot were tested statistically and differences between lots were significant at the five per cent level. Feed efficiency was not tested statistically because data were collected as lot averages. It is noted, however, that Lot 1 which was restricted to maintenance during wintering, appeared the most efficient lot in feed conversion.

The most rapid gains on the fattening ration were made by Lot 2 which averaged 0.45 pound daily gain during wintering. Feed conversion of the animals in this lot was less efficient than Lot 1.

Animals in Lot 3 gained less in feed lot and appeared to be the least efficient in feed conversion of the four treatment groups. Lot 4 animals, which were on a high plane of nutrition during wintering, were less efficient than either Lot 1 or Lot 2 animals in feed conversion.

The animals in this lot gained more rapidly than did Lot 3 animals and required slightly less feed per hundred pounds of gain.

The relatively high feed conversion ratios of these four groups may be explained in part by the fact that the feed lots were in the open and several times during the fattening period, the lots unavoidably became excessively wet and muddy to the extent that it was difficult for the animals to feed from the bunkers. A further factor may be found on review of the literature; numerous workers have reported that heifers are less efficient in the feed lot than steers.

The Effect of Winter Supplementation on Certain Slaughter Characteristics

The Effect of Winter Supplementation on Intransit Shrink

The cattle were trucked from the Range Cattle Station at Ona to Gainesville. Intransit shrink was calculated from the weights taken prior to hauling and the Gainesville arrival weights. Differences between lots were small and insignificant when tested statistically. Lots 1, 2, 3, and 4 had an average intransit shrink of 5.47, 5.30, 6.05, and 5.83 per cent respectively as shown in Table 7.

The Effect of Winter Supplementation on Caul and Ruffle Fat, Gastro-intestinal Tract and Fill

Differences among the four lots in per cent gastro-intestinal tract, per cent caul and ruffle fat, and per cent fill at slaughter lacked significance. Lot averages are shown in Table 7.

TABLE 7

THE EFFECTS OF WINTER SUPPLEMENTATION ON PER CENT INTRANSIT SHRINK, PER CENT OF GASTRO-INTESTINAL TRACT, PER CENT FILL, PER CENT CAUL AND RUFFLE FAT, AND DRESSING PER CENT

	Percentage				
Lot No.	Intransit Shrink	Avg. G. I. Tract	Avg. Fill	Avg. Caul and Ruffle Fat	Avg. Dressing Percentage
1	5.47	11.34	3.06	5.24	58.14
2	5.30	10.06	3.66	4.94	60.32
3	6.05	10.08	3.04	4.58	60.32
4	5.83	10.16	3.63	5.19	61.49
Significance of Difference	N.S.	N.S.	N.S.	N.S.	**

N.S. -- differences were not statistically significant.

**Difference significant at the one per cent level of probability.

The Effect of Winter Supplementation on Dressing Per Cent

Dressing per cent was calculated on Gainesville arrival weights and weight of the carcass after forty-eight hours chill. Lot differences in dressing per cent were highly significant. Lot 1 had the lowest average dressing per cent of the four lots with 58.14 per cent. Since statistical analysis showed only insignificant differences in per cent gastro-intestinal tract, per cent caul and ruffle fat, and per cent fill, and since finish is known to contribute to dressed yield, the low dressing per cent of Lot 1 reflects a lack of finish compared to the other lots.

Both Lot 2 and Lot 3 heifers averaged 60.32 in dressing per cent. Lot 4 animals had an average dressing per cent of 61.49 which indicates that this lot which was on the highest nutritional plane during wintering was also the fattest at completion of the feed lot period. Differences between lots as shown in Table 7 were significant at the one per cent level.

The Effect of Winter Supplementation on Certain Carcass Characteristics

The Effect of Winter Supplementation on Subjective Marbling Determination

Lot differences in degree of marbling were statistically significant at the five per cent level as shown in Table 8. Lot 1 animals had the least amount of marbling with an average score of 3.27, indicating slightly more than trace marbling in the rib eye. The average marbling score for Lot 2 was highest with 4.82, indicating slight marbling but

TABLE 8

THE EFFECTS OF WINTER SUPPLEMENTATION ON CARCASS GRADE AND FACTORS CONTRIBUTING TO GRADE

Lot No.	Govt. Carcass Grade[a]	Marbling Score[b]	Conformation[a] Equivalent	Outside Finish[a]	Inside Quality[a]
1	12.64	3.27	12.64	14.27	13.73
2	14.82	4.82	15.27	16.64	15.64
3	13.45	3.73	13.64	15.55	14.36
4	14.64	4.64	15.09	17.00	15.45
Significance of Difference	**	*	**	**	*

*Significant at the five per cent level.

**Significant at the one per cent level.

[a] Scored on basis of: 10 - low Standard, 11 - average Standard, 12 - high Standard, 13 - Low Good, 14 - average Good, 15 - high Good, 16 - low Choice.

[b] Marbling scores on basis of: 1 - devoid, 2 - practically devoid, 3 - trace, 4 - slight, 5 - small, 6 - modest.

approaching small amount. Lot 3 had an average score of 3.73 which is slightly higher than Lot 1 and close to a slight amount of marbling. The animals in Lot 4 had an average score of 4.64.

The Effect of Winter Supplementation on Carcass Grade and Grade Factors

Carcass conformation, outside finish and inside quality values are presented in Table 8. Average conformation values were 12.64, 15.27, 13.64, and 15.09 for Lots 1 through 4 respectively.

Conformation scores of Lot 1 were considerably lower than the other three lots. The average carcass conformation of Lot 1 was high Standard; carcasses of Lot 2 had average conformation of high Good; Lot 3 carcasses followed Lot 1 cattle with an average conformation equivalent of low Good. The average conformation equivalent of Lot 4 was high Good. Lot differences as to conformation were highly significant at the one per cent level as shown in Table 8.

Lot differences in outside finish were highly significant. Shown in Table 8, Lot 1 carcasses averaged average Good; carcasses of Lot 2 averaged Low Choice; Lot 3 carcasses averaged high Good; Lot 4 had the highest average outside finish with average Choice.

Differences in inside quality shown in Table 8 were significant at the five per cent level. Lot 1 had the lowest average inside quality with Low Good. Lot 2 had the highest inside quality with an average of high Good. Lot 3 followed Lot 1 with an average Good and Lot 4 had the same average as Lot 2 with high Good.

Carcass grade differences among lots as presented in Table 8 were significant at the one per cent level of probability. Lot 1 carcasses averaged high Standard with one high Good carcass, two average Goods, one low Good, six high Standard, and one average Standard carcass.

Lot 2 had an average carcass grade of average Good. This lot provided one top Standard carcass, one low Good, three average Good, one top Good, four low Choice carcasses, and one average Choice carcass.

Carcass grades for Lot 3 averaged Low Good. Lot 3 had one average Standard and one top Standard carcass, also four low Good, three average Good, one top Good, and one low Choice carcass.

Lot 4 had the same average carcass grade as Lot 2 -- average Good. Lot 4 had three low Good carcasses, four average Good, two low Choice, and two average Choice carcasses. Lot 2 had five Choice carcasses whereas Lot 4 had only four Choice carcasses. However, there were no Standard carcasses in Lot 4.

It is noted that Lot 1 carcasses scored lower in conformation, outside finish, inside quality, marbling, and carcass grade than the other three lots; these differences were statistically significant. These data thus suggest that the degree of restriction during wintering of Lot 1 was severe enough to decrease the gradability of carcass for this lot. The reason for the low gradability of Lot 3 carcasses when compared to Lots 2 and 4 has no apparent substantial explanation in winter nutritional levels. Although Lot 3 was wintered at a higher nutritional level than Lot 2, Lot 2 carcasses consistently scored higher than Lot 3 carcasses and compared favorably with carcasses from Lot 4.

The Effect of Winter Supplementation on Certain Carcass Measurements

Carcass length, length of leg, circumference of round, chuck thickness, and L. dorsi area data are presented in Table 9. Lot differences in carcass length, length of leg, and chuck thickness were not statistically significant. However, Lot 1 carcasses averaged 28.89 inches in circumference of round and Lot 4 averaged 29.09 inches, the difference, which is significant at the five per cent level, indicating that the animals wintered on a low plane of nutrition had significantly smaller rounds than those wintered on the high level of nutrition. Lots 2 and 3 were intermediate in circumference of round with 28.45 and 28.76 inches respectively.

Lot differences in area of the L. dorsi were small and lacked significance. However, when adjusted on the basis of square inches of rib eye area per hundred pounds of carcass, the differences between lots approach statistical significance. Lot 1 carcasses had 1.96 square inches of rib eye area per hundred pounds of carcass weight as compared to 1.73 square inches for Lot 4. Lots 2 and 3 were intermediate with 1.86 and 1.88 square inches respectively.

Differences in depth of fat over the L. dorsi muscle are presented in Table 9 and are significant at the one per cent level. Lot averages for Lots 1 through 4 were 0.54, 0.74, 0.62, and 0.80 inches respectively.

The Effect of Winter Supplementation on the Fat, Lean, Bone, and Connective Tissue Constituents of the 9-10-11 Rib Cut

Differences in separable fat, lean, bone, and connective tissue

TABLE 9

THE EFFECTS OF WINTER SUPPLEMENTATION ON LENGTH OF CARCASS, CIRCUMFERENCE OF ROUND, LENGTH OF LEG, CHUCK THICKNESS, AND AREA OF THE *L. DORSI*

Lot No.	Length of Carcass (in.)	Circumference Area of Round (in.)	Length of Leg (in.)	Chuck Thickness (in.)	Circumference Area of *L. Dorsi* (sq. in.)	Sq. In. *L. Dorsi* 100 Lbs. Carcass Weight
1	42.71	26.89	28.14	5.60	7.59	1.96
2	42.84	28.46	28.32	6.06	7.99	1.86
3	43.19	28.76	28.72	5.76	7.84	1.88
4	44.10	29.09	28.90	6.01	8.08	1.73
Significance of Difference	N. S.	*	N. S.	N. S.	N. S.	N. S.

N. S. -- Difference not statistically significant.

*Difference significant at the five per cent level of probability.

are shown in Table 10. Lot 1 had the lowest percentage of separable fat with 33.30, followed closely by Lot 3 with 33.86 per cent. Lot 2 had 37.54 per cent and Lot 4 had the highest percentage of separable fat with 38.58. Lot differences in separable fat were significant at the five per cent level.

Per cent separable lean for Lot 1 was 48.96 and for Lot 2, 46.16. Lot 3 closely followed Lot 1 with an average of 48.73 per cent and Lot 4 had the lowest average with 45.07.

Differences in lot averages of per cent bone in the 9-10-11 rib cut were slight. Lots 1 through 4 had averages of 17.03, 15.21, 15.92, and 15.68 per cent respectively. Lot differences in per cent separable connective tissue were also small. Lots 1 through 4 had averages of 1.46, 1.21, 1.70, and 1.10 per cent respectively.

Differences in per cent separable lean, bone, and connective tissue when tested statistically were insignificant. It will be noted, Lot 1 had less fat, more lean, and more bone than the other lots, whereas Lot 4 apparently had more fat and less lean.

Lack of statistical significance in per cent of separable lean corroborates the lack of significance in lot differences between rib eye areas, as both are accepted measures of meatiness in beef carcasses.

The lack of statistical significance between differences in per cent of bone and connective tissue may be explained by the wide variation that existed within lots. These data indicate however, that level of nutrition during wintering does have an effect on carcass fat deposition which carried through the feed lot period.

TABLE 10

THE EFFECTS OF WINTER SUPPLEMENTATION ON FAT DEPTH OVER THE L. DORSI AND FAT, LEAN, BONE, AND CONNECTIVE TISSUE COMPONENTS OF THE 9-10-11 RIB CUT

Lot No.	Fat Depth Over L. Dorsi (In.)	Sep. Fat (Per Cent)	Sep. Lean (Per Cent)	Bone (Per Cent)	Connective Tissue (Per Cent)
1	0.54	33.30	48.96	17.03	1.46
2	0.74	37.55	46.16	15.21	1.21
3	0.62	33.86	48.74	15.92	1.70
4	0.80	38.58	45.07	15.68	1.10
Significance of Difference	**	*	N. S.	N. S.	N. S.

*Significant at the 5 per cent level of probability.

**Significant at the 1 per cent level of probability.

N. S. — difference not statistically significant.

The Effect of Winter Supplementation on Tenderness of Steaks and Roasts

Tenderness evaluations were made by both taste panel and Warner-Bratzler shear apparatus on unaged and aged steaks and roasts. Tenderness data are presented in Table 11.

Taste panel values for unaged steaks were 3.7, 3.8, 4.1, and 4.0 for Lots 1 through 4 respectively. Corresponding shear values were 11.9, 10.3, 10.6, and 10.9. Higher panel values indicate increasing tenderness whereas lower shear values denote tenderness. These values though insignificant statistically indicate a slight trend for Lot 1 to be the less tender.

Taste panel values for aged steaks were 4.6, 4.6, 5.0, and 4.7 for Lots 1 through 4 respectively. Corresponding shear values were 10.7, 10.5, 9.9, and 10.1. Lot differences when tested statistically were insignificant, however, the tenderizing effect of the aging may be noted. All values indicated increased tenderness with the exception of the shear value for steaks from Lot 2. The taste panel average for Lot 2 indicated a tenderizing effect whereas the shear value average was slightly higher for the aged steaks.

Taste panel values for unaged 6-7-8 rib roasts were 5.0, 4.9, 4.4, and 4.6 for Lots 1 through 4 respectively. Corresponding shear values were 10.3, 10.4, 10.7, and 10.3.

Taste panel values for aged 6-7-8 rib roasts were 5.3, 5.2, 5.2, and 5.2 for Lots 1 through 4 respectively. Corresponding shear values were 9.8, 9.7, 9.4, and 9.0.

Lot differences in tenderness when tested statistically were

TABLE 11

THE EFFECTS OF WINTER SUPPLEMENTATION ON THE TENDERNESS OF UNAGED AND AGED STEAKS AND ROASTS

Lot No.	Unaged Steaks		Aged Steaks		Unaged Roasts		Aged Roasts	
	Taste Panel	W - B Shear	Taste Panel	W - B Shear	Taste Panel	W - B Shear	Taste Panel	W - B Shear
1	3.7	11.9	4.6	10.7	5.0	10.3	5.3	9.8
2	3.8	10.3	4.6	10.5	4.9	10.4	5.2	9.7
3	4.1	10.6	5.0	9.9	4.4	10.7	5.2	9.4
4	4.0	10.9	4.7	10.1	4.6	10.3	5.2	9.0
Significance of Difference	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N. S. -- Difference not statistically significant.

not significant. Differences in tenderness in roasts tend to be minimized due to method of cookery; however, even with the differences in roast tenderness lessened by the method of cookery, the tenderizing effect of the seven day aging period was still evident.

These data indicate that wintering treatment exerted no significant influence on tenderness of steaks and roasts as tested by taste panel and Warner-Bratzler shear apparatus. However, the tenderizing effect of aging for seven days is indicated although these differences between aged and unaged steaks and roasts were not tested statistically.

The Effect of Winter Supplementation on Juiciness of Steaks and Roasts

Lot differences in juiciness as evaluated by taste panel are presented in Table 12. Juiciness values of unaged steaks were 4.5, 5.0, 4.7, and 4.5 for Lots 1 through 4 respectively. Corresponding values for the aged steaks were 4.2, 4.5, 4.5, and 4.3. Panel values of unaged roasts were 4.6, 5.0, 4.8, and 5.1 for Lots 1 through 4 respectively. Corresponding values for aged roasts were 4.7, 4.8, 4.7, and 5.1. Lot differences in juiciness were insignificant statistically.

These data indicate a slight trend for the steaks to become less juicy on aging, however, differences between juiciness of unaged and aged samples were not tested statistically.

The Effect of Winter Supplementation on Chemical Moisture, Fat, and Protein of the L. Dorsi and 9-10-11 Rib Cut

Results of moisture and fat determinations of ground samples of

TABLE 12

THE EFFECTS OF WINTER SUPPLEMENTATION ON JUICINESS OF UNAGED AND AGED STEAKS AND ROASTS

Lot No.	Unaged		Aged	
	Steaks	Roasts	Steaks	Roasts
1	4.5	4.6	4.2	4.7
2	5.0	5.0	4.5	4.8
3	4.7	4.8	4.5	4.7
4	4.5	5.1	4.3	5.1
Significance of Difference	N.S.	N.S.	N.S.	N.S.

N.S. -- Difference not statistically significant.

L. dorsi muscle are presented in Table 13. Average per cent moisture of the rib eye samples for Lots 1 through 4 respectively was 72.66, 72.73, 72.13, and 71.88. Per cent fat, expressed on a wet weight basis was 2.94, 3.07, 3.38, and 3.64 for Lots 1 through 4 respectively. Lot differences in per cent fat and moisture in the L. dorsi were not statistically significant.

Determinations for fat, moisture, and protein of the ground separable fat and lean portion of the 9-10-11 rib cut are shown in Table 13. Lot averages for per cent moisture were 48.72, 45.57, 48.44, and 44.38 for Lots 1 through 4 respectively.

Per cent fat of the 9-10-11 rib cut was 35.82, 40.36, 36.22, and 41.58 for Lots 1 through 4 respectively and per cent protein for the corresponding lots were 15.24, 14.11, 15.06, and 13.60. Lot differences in per cent moisture, fat, and protein were statistically significant at the five per cent level.

It is noted, that Lot 1 had significantly less fat and more protein than either Lot 2 or Lot 4. Lots 2 and 4 were closely associated in per cent fat and protein whereas Lot 3 values were much closer to Lot 1. Per cent moisture was inversely related to per cent fat. Therefore, it appears that level of nutrition during wintering affected the degree of fatness of Lot 1 carcasses and thus, per cent moisture and protein. Lot 3 fat, moisture, and protein values were very similar to Lot 1; which may be explained by the comparatively poor feed lot performance of Lot 3. Although Lot 3 had the second highest supplementation during winter, their feed lot gains were the lowest of the four lots and the degree of fatness was not as

TABLE 13

THE EFFECTS OF WINTER SUPPLEMENTATION ON THE CHEMICAL DETERMINATION OF PER CENT MOISTURE AND ETHER EXTRACT OF THE L. DORSI AND OF PER CENT MOISTURE, ETHER EXTRACT AND PROTEIN OF THE 9-10-11 RIB CUT

	L. Dorsi		9-10-11 Rib Cut		
Lot No.	Moisture	Ether Extract	Moisture	Ether Extract	Protein
1	72.66	2.94	48.72	35.82	15.24
2	72.73	3.07	45.57	40.36	14.11
3	72.13	3.38	48.44	36.22	15.06
4	71.88	3.64	44.38	41.58	13.60
Significance of Difference	N.S.	N.S.	*	*	*

N.S. -- Difference not statistically significant.

*Difference significant at the five per cent level of probability.

great as that of either Lot 2 or Lot 4.

The Relationship Between Wintering Average Daily Gain, Feed Lot Average Daily Gain and Certain Slaughter and Carcass Characteristics as Determined by Simple Correlation Coefficients

This section disregards treatment groups and deals with coefficients of correlation among the variables studied for the forty-four animals. Since the primary objectives of this trial were concerned with winter gain as it subsequently affects feed lot performance, slaughter, and carcass characteristics, the relationship between these variables was studied. Also of further interest was the relationship between feed lot performance following the winter treatment and slaughter and carcass characteristics. These factors will be considered together in this section.

The Relationship Between Wintering Gain and Feed Lot Average Daily Gain

The correlation coefficient between average daily gain during wintering and average daily gain in feed lot was -.14 as shown in Table 14. The negative relationship, though statistically insignificant, indicates a trend for the animals gaining slower during wintering to gain faster in the feed lot.

The Relationship Between Weight Gains and Certain Slaughter Characteristics

Correlation coefficients for winter daily gain and feed lot daily gain with slaughter characteristics are presented in Table 14. Correlation coefficients between winter daily gain and feed lot daily gain with intransit shrink were .15 and .25 respectively. The correlation

TABLE 14

THE RELATIONSHIP BETWEEN RATE OF GAIN, INTRANSIT SHRINK, PER CENT GASTRO-INTESTINAL TRACT, PER CENT FILL, AND DRESSING PER CENT

Source of Variation	Correlation Coefficient
Winter Average Daily Gain and	
Feed lot average daily gain, lbs.	-.14
Intransit shrink, per cent	.15
Gastro-intestinal tract, per cent	.01
Fill, per cent	-.08
Dressing per cent	.54**
Feed Lot Average Daily Gain and	
Feed lot average daily gain, lbs.	---
Intransit shrink, per cent	.25
Gastro-intestinal tract, per cent	.03
Fill, per cent	.10
Dressing per cent	-.07

**Significant at the one per cent level of probability.

coefficients lacked significance, however, the degree of association between gain and intransit shrink indicate that animals gaining faster in feed lot lost more weight on the trip to Gainesville.

Both per cent gastro-intestinal tract and per cent fill had insignificant and very low degree of association with wintering daily gains and feed lot daily gains. Correlation coefficients of .01 and -.08 between wintering daily gains and gastro-intestinal tract and fill were found. Correlations of .03 and .10 between feed lot daily gains and gastro-intestinal tract and fill were found.

Correlation coefficients between wintering daily gains and feed lot daily gains with dressing per cent were .54 and -.07 respectively. The relationship between wintering gains and dressing per cent was significant at the one per cent level of probability, indicating that the animals that gained more during wintering were fatter following the feed lot period and therefore had higher dressing percentages.

The low insignificant correlation coefficient between feed lot gains and dressing per cent was negative because the animals that were restricted during wintering tended to gain faster in feed lot but on a lot basis dressed significantly lower.

The relationships between either wintering gains or feed lot gains and intransit shrink, gastro-intestinal tract and fill were slight and statistically insignificant. These data therefore indicate that weight gains in this study had little or no effect on the particular slaughter characteristics mentioned above. However, the highly significant correlation coefficient between winter gains and dressing per cent indicates that the winter gains strongly influenced dressing percentage.

The Relationship Between Weight Gains and Certain Carcass Characteristics

Correlation coefficients between wintering gains and marbling and feed lot gains and marbling were .31 and .44 respectively as shown in Table 15. These data indicate that gains during wintering and feed lot both are significantly associated with marbling. However, the correlation between winter gains and marbling, significant at the five per cent level, was not as close as the relationship between feed lot gain and marbling which was significant at the one per cent level of probability.

Correlation coefficients of grade and grade factors with weight gains are presented in Table 15. Correlation coefficients between winter gain and carcass conformation and feed lot gain and carcass conformation were .40 and .34 respectively which were significant at the one per cent level and five per cent level. Correlation coefficients between wintering gains and outside finish and feed lot gains and outside finish were .42 and .31, which were significant at the one and five per cent levels respectively. Correlations between wintering gains and inside quality and feed lot gains and inside quality were .24 and .46, the latter significant at the one per cent level. Carcass grade had a coefficient of correlation of .38, significant at the one per cent level, with winter gains and correlation of .48 with feed lot gains, also significant at the one per cent level.

The data therefore indicate that wintering gains had more influence on carcass conformation and outside finish than did feed lot gains. However, feed lot gains were more closely associated with inside quality and carcass grade than were wintering gains. Animals that

TABLE 15

THE RELATIONSHIP BETWEEN AVERAGE DAILY WEIGHT GAINS AND CARCASS GRADE AND GRADE FACTORS

Source of Variation	Correlation Coefficient
Winter Average Daily Gain and	
Marbling Score	.31*
Carcass conformation	.40**
Outside finish	.42**
Inside quality	.24
Carcass grade	.38**
Feed Lot Average Daily Gain and	
Marbling Score	.44**
Carcass conformation	.34*
Outside finish	.31*
Inside quality	.46**
Carcass grade	.48**

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

gained more weight during wintering were superior in carcass conformation and had more outside finish following the feed lot period.

Correlation coefficients of carcass measurements with weight gains are shown in Table 16. Correlation coefficients of carcass length, length of leg, circumference of round and chuck thickness with wintering gains were .58, .24, .65, and .44 respectively, which with the exception of length of leg were significant at the one per cent level. Correlations of feed lot gains with carcass length, length of leg, circumference of round and chuck thickness were .42, .04, .45, and .50 respectively. The coefficients of correlation, significant at the one per cent level with the exception of leg length, indicate an association between carcass measurements with both winter gains and feed lot gains; although the relationship with winter gain seemed to be closer.

Area of the L. dorsi muscle between the twelfth and thirteenth ribs had a coefficient of correlation with wintering gains of .20 and lacked significance as shown in Table 16. However, the coefficient of correlation with feed lot gains was .38, significant at the one per cent level, indicating that feed lot gains were more closely associated with carcass muscling than were wintering gains. This association, although significant, explained only little more than fourteen per cent of the variation.

When rib eye area was adjusted to square inches of rib eye per hundred pounds of carcass weight and then related to wintering and feed lot gains, correlation coefficients were -.56 and -.30 respectively as presented in Table 16. The highly significant negative relationship with wintering gains points to the animals gaining less during wintering

TABLE 16

THE RELATIONSHIP BETWEEN AVERAGE DAILY WEIGHT GAIN AND CARCASS LENGTH, LENGTH OF LEG, CIRCUMFERENCE OF ROUND, CHUCK THICKNESS, AND RIB EYE AREA

Source of Variation	Correlation Coefficient
Winter Average Daily Gain and	
Carcass length, inches	.58**
Length of leg, inches	.24
Circumference of round, inches	.65**
Chuck thickness, inches	.44**
Rib eye area, sq. inches	.20
Square inches rib eye 100 lbs. carcass weight	-.56**
Feed Lot Average Daily Gain and	
Carcass length, inches	.42**
Length of leg, inches	.04
Circumference of round, inches	.45**
Chuck thickness, inches	.50**
Rib eye area, sq. inches	.38**
Square inches rib eye 100 lbs. carcass weight	-.30*

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

as having a larger area of rib eye per hundred pounds of carcass. Analysis of variance indicated that little or no difference in area of *L. dorsi* as such existed between lots; therefore, on a rib eye area per hundred pounds weight basis, lighter carcasses from restricted animals were leaner and meatier. This relationship changed with feed lot gains because Lot 2 animals gained rapidly in feed lot and therefore had relatively heavy carcasses.

The relationship of depth of fat over the rib eye with winter and feed lot gains is presented in Table 17. A coefficient of correlation of .30 was found between depth of fat over the rib eye and winter daily gain; the relationship was significant at the five per cent level. The correlation coefficient between depth of fat and feed lot gain was an insignificant .21. These relationships indicate that wintering gains more strongly influence external fat deposition than feed lot gains.

The Relationship Between Weight Gains and the Fat, Lean, Bone, and Connective Tissue Constituents of the 9-10-11 Rib Cut

The relationships between fat, lean, bone, and connective tissue components of the 9-10-11 rib cut and weight gains are presented in Table 17. A correlation of -.36 was obtained between separable lean of the 9-10-11 rib cut and wintering gain; the relationship was significant at the five per cent level and indicates the trend for animals gaining less during wintering to have more lean in the 9-10-11 rib cut. The association of separable lean with feed lot gain was insignificant when tested statistically as was the association between feed lot gain

TABLE 17

THE RELATIONSHIP BETWEEN AVERAGE DAILY WEIGHT GAIN AND DEPTH OF FAT OVER THE RIB EYE AND PER CENT SEPARABLE FAT, LEAN, BONE, AND CONNECTIVE TISSUE OF THE 9-10-11 RIB CUT

Source of Variation	Correlation Coefficient
Winter Average Daily Gain and	
Depth of fat over rib eye, inches	.30*
Per cent separable fat of the 9-10-11 rib cut	.40**
Per cent separable lean of the 9-10-11 rib cut	-.36*
Per cent separable bone	-.32*
Per cent separable connective tissue	-.05
Feed Lot Average Daily Gain and	
Depth of fat over rib eye, inches	.21
Per cent separable fat of the 9-10-11 rib cut	.32*
Per cent separable lean of the 9-10-11 rib cut	-.23
Per cent separable bone	-.29*
Per cent separable connective tissue	-.30*

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

and per cent bone. However, the correlation between winter gain and per cent bone was significant at the five per cent level with a coefficient of -.32.

The Relationship Between Weight Gains and Chemical Moisture, Fat, and Protein of the *L. Dorsi* and 9-10-11 Rib Cut

The relationships between rate of gain and moisture and fat content of the *L. dorsi* muscle are presented in Table 18. Both winter gain and feed lot gain were significantly associated at the one per cent level with per cent moisture in the *L. dorsi* muscle with correlations of -.46 and -.38 respectively. Thus, fatter animals had less moisture in the rib eye. Since moisture and fat or ether extract are inversely related, it was reasonable that the fatter animals had more ether extract in the rib eye. Correlation coefficients of .38 and .32 between winter gain and feed lot gain with ether extract of the rib eye muscle were significant at the one and five per cent levels respectively, illustrating that the fatter, faster gaining animals did have more ether extract and therefore less moisture in the rib eye.

The relationships between rate of gain and moisture, fat, and protein of the 9-10-11 rib cut are shown in Table 18. Moisture and ether extract of the 9-10-11 rib cut had significant coefficients of correlation with winter gain of -.37 and .36. A highly significant correlation coefficient of -.42 was obtained between per cent protein of this cut and winter gain. Feed lot gain with moisture, ether extract, and protein of the 9-10-11 rib cut had coefficients of correlation of -.37, .35, and -.31 respectively which were significant at the five

TABLE 18

THE RELATIONSHIP BETWEEN AVERAGE DAILY WEIGHT GAIN AND PER CENT MOISTURE, FAT, AND PROTEIN OF THE *L. DORSI* AND THE 9-10-11 RIB CUT

Source of Variation	Correlation Coefficient
Winter Average Daily Gain and	
Per cent moisture of *L. dorsi*	-.46**
Per cent ether extract of *L. dorsi*	.38**
Per cent moisture 9-10-11 rib cut	-.37*
Per cent ether extract 9-10-11 rib cut	.36*
Per cent protein 9-10-11 rib cut	-.42**
Feed Lot Average Daily Gain and	
Per cent moisture of *L. dorsi*	-.38**
Per cent ether extract of *L. dorsi*	.32*
Per cent moisture 9-10-11 rib cut	-.37*
Per cent ether extract 9-10-11 rib cut	.35*
Per cent protein 9-10-11 rib cut	-.31*

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

per cent level.

The Relationship Between Weight Gains and Tenderness of Both Unaged and Aged Steaks and Roasts

Tenderness values of steaks and roasts were not significantly associated with either winter gain or feed lot gain as seen in Table 19. Correlation coefficients of .05 and -.10 were found between panel values for unaged steaks and winter gain and feed lot gain respectively. Winter gain and feed lot gain had correlations of .02 and -.09 with shear values for unaged steaks. Taste panel values for aged steaks had correlations of .15 and -.09 with winter gain and feed lot gain. Correlation coefficients of -.13 and .01 were found between shear values for aged steaks and winter gain and feed lot gain respectively.

Tenderness panel values for unaged roasts had correlations of -.22 and .18 with winter gain and feed lot gain. The shear values for unaged roasts had correlations of .03 and -.27 with winter gain and feed lot gain respectively. Correlation coefficients of .02 and .14 were found between panel values for aged roasts and winter and feed lot gains. Shear values for aged roasts had correlations of -.16 and -.01 with winter gain and feed lot gain respectively.

The Relationship Between Carcass Grade and Tenderness of Both Unaged and Aged Steaks and Roasts

The relationships between tenderness of steaks and roasts and carcass grade are presented in Table 20. Coefficients of correlation between carcass grade and tenderness values for steaks both aged and unaged were not significant. With unaged roasts, however, correlation

TABLE 19

THE RELATIONSHIP BETWEEN AVERAGE DAILY WEIGHT GAIN AND TENDERNESS OF STEAKS AND ROASTS

Source of Variation	Correlation Coefficient
Winter Average Daily Gain and	
Panel values, unaged steaks	.05
Shear values, unaged steaks	.02
Panel values, aged steaks	.15
Shear values, aged steaks	-.13
Panel values, unaged roasts	-.22
Shear values, unaged roasts	.03
Panel values, aged roasts	.02
Shear values, aged roasts	-.16
Feed Lot Average Daily Gain and	
Panel values, unaged steaks	-.10
Shear values, unaged steaks	-.09
Panel values, aged steaks	-.09
Shear values, aged steaks	.01
Panel values, unaged roasts	.18
Shear values, unaged roasts	-.27
Panel values, aged roasts	.14
Shear values, aged roasts	-.01

TABLE 20

SIMPLE CORRELATIONS BETWEEN TENDERNESS VALUES OF UNAGED AND AGED STEAKS AND ROASTS AND CARCASS GRADE, MARBLING, PER CENT ETHER EXTRACT OF THE L. DORSI, METATARSUS BREAKING STRENGTH AND METACARPUS BREAKING STRENGTH

Source of Variation	Correlation Coefficient
Carcass Grade and	
Panel values, unaged steaks	.11
Shear values, unaged steaks	-.26
Panel values, aged steaks	.16
Shear values, aged steaks	-.17
Panel values, unaged roasts	.31*
Shear values, unaged roasts	-.33*
Panel values, aged roasts	.25
Shear values, aged roasts	-.32*
Marbling Score and	
Panel values, unaged steaks	.07
Shear values, unaged steaks	-.18
Panel values, aged steaks	.18
Shear values, aged steaks	-.12
Panel values, unaged roasts	.27
Shear values, unaged roasts	-.27
Panel values, aged roasts	.29*
Shear values, aged roasts	-.33*
Per Cent Ether Extract L. Dorsi and	
Panel values, unaged steaks	.25
Shear values, unaged steaks	-.15
Panel values, aged steaks	.40**
Shear values, aged steaks	-.25
Panel values, unaged roasts	.34*
Shear values, unaged roasts	-.36*
Panel values, aged roasts	.49**
Shear values, aged roasts	-.35*

TABLE 20--Continued

Source of Variation	Correlation Coefficient
Metatarsus Breaking Strength and	
Panel values, unaged steaks	-.38**
Shear values, unaged steaks	.38**
Panel values, aged steaks	-.53**
Shear values, aged steaks	.43**
Panel values, unaged roasts	-.55**
Shear values, unaged roasts	.40**
Panel values, aged roasts	-.50**
Shear values, aged roasts	.48**
Metacarpus Breaking Strength and	
Panel values, unaged steaks	-.14
Shear values, unaged steaks	-.09
Panel values, aged steaks	-.24
Shear values, aged steaks	.02
Panel values, unaged roasts	-.21
Shear values, unaged roasts	-.06
Panel values, aged roasts	-.37*
Shear values, aged roasts	.12

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

coefficients between carcass grade were .31 and -.33 for panel and shear values respectively. These were significant at the five per cent level. Correlation coefficients between carcass grade and aged roasts were .25 and -.32 for panel and shear values, the latter significant at the five per cent level.

The Relationship Between Marbling and Ether Extract of the L. dorsi with Tenderness of both Unaged and Aged Steaks and Roasts

Degree of marbling was not significantly associated with tenderness values of unaged steaks or roasts. However, a low but significant correlation of .29 between marbling and panel values of aged roasts was found. A significant correlation of -.33 between marbling and shear values of aged roasts was obtained.

The relationships between marbling and ether extract of the *L. dorsi* and panel and shear tenderness values of aged and unaged steaks and roasts are presented in Table 20. Ether extract of the *L. dorsi* was more closely associated with tenderness values than marbling score. Coefficients of correlation between ether extract of the *L. dorsi* and unaged steak tenderness values lacked significance. However, taste panel values for the aged steaks had a coefficient of correlation with ether extract of .40 which was significant at the one per cent level. Shear values lacked significance. Taste panel values and shear values both of unaged and aged roasts were significantly associated with ether extract of the *L. dorsi*. Unaged roast coefficients of correlation with ether extract of the *L. dorsi* for panel and shear values were .34 and and -.36 respectively, which were significant at the five per cent level. Ether extract of the L. dorsi had correlations of .49 and -.35 with panel and shear values for tenderness of aged roasts which were significant at the one and five per cent level respectively.

The Relationship Between Metacarpus and Metatarsus Breaking Strength and Tenderness of Both Unaged and Aged Steaks and Roasts

Correlation coefficients between metacarpus and metatarsus breaking strength and tenderness as determined by panel and shear are presented in Table 20. In this study, it was interesting to note the relatively close relationship which existed between breaking strength of the metatarsus and panel and shear tenderness values for unaged and aged steaks and roasts. Coefficients of correlation between metatarsus breaking strength and taste panel and shear values for unaged steaks were -.38 and .38 respectively which were significant at the one per cent level. With aged steaks, a correlation of -.53 was found between panel tenderness and metatarsus breaking strength; a correlation of .43 was found between shear value and metatarsus breaking strength. Both correlations were highly significant. Coefficients of correlation between metatarsus breaking strength and unaged roast tenderness values by panel and by shear were -.55 and .40, respectively; both correlations were highly significant. With aged roasts, highly significant correlation coefficients of -.50 and .48 were found between the breaking strength of the metatarsus and tenderness by panel and between the breaking strength of the metatarsus and tenderness by shear respectively.

Correlations between metacarpus breaking strength and tenderness values were generally low and lacked significance with one exception. A correlation coefficient of -.37 which was significant at the five per cent level, existed between metacarpus breaking strength and panel tenderness values of aged roasts.

The Relationship Between Weight Gains and Juiciness of Both Unaged and Aged Steaks and Roasts

The relationship between the juiciness of steaks and roasts and rate of winter and feed lot gain may be seen in Table 21. Taste panel values for juiciness of steaks and roasts were not significantly associated with winter gains. However, panel values for juiciness of unaged steaks and feed lot gain provided a coefficient of correlation of .29 which was significant at the five per cent level. Coefficients of correlation between feed lot gain and aged steaks and unaged and aged roast juiciness lacked significance.

The Relationship Between Carcass Grade and Juiciness of Both Unaged and Aged Steaks and Roasts

The association of carcass grade with juiciness is presented in Table 22. Carcass grade was associated with juiciness of unaged steaks and aged steaks with correlations of .42 and .34 respectively, which were significant at the one and five per cent levels. Juiciness of roasts was significantly associated with carcass grade, having coefficients of correlation of .38 for unaged roasts and .29 for aged roasts which were significant at the one and five per cent level respectively.

TABLE 21

THE RELATIONSHIP BETWEEN AVERAGE DAILY WEIGHT GAIN AND JUICINESS OF STEAKS AND ROASTS

Source of Variation	Correlation Coefficient
Winter Average Daily Gain and	
Juiciness of unaged steaks	-.02
Juiciness of aged steaks	.27
Juiciness of unaged roasts	.23
Juiciness of aged roasts	.18
Feed Lot Average Daily Gain and	
Juiciness of unaged steaks	.29*
Juiciness of aged steaks	.12
Juiciness of unaged roasts	.13
Juiciness of aged roasts	.17

*Significant at the five per cent level of probability.

TABLE 22

THE RELATIONSHIP BETWEEN JUICINESS OF UNAGED AND AGED STEAKS AND ROASTS AND CARCASS GRADE, MARBLING, PER CENT ETHER EXTRACT OF THE L. DORSI AND TENDERNESS AS DETERMINED BY PANEL

Source of Variation	Juiciness of			
	Unaged Steaks	Aged Steaks	Unaged Roasts	Aged Roasts
Carcass Grade	.42**	.34*	.38**	.29*
Marbling Score	.48**	.25	.40**	.40**
Per Cent Ether Extract L. dorsi	.26	.30*	.31*	.39**
Tenderness Taste Panel Unaged Steaks	-.13	---	---	---
Tenderness Taste Panel Aged Steaks	---	.26	---	---
Tenderness Taste Panel Unaged Roasts	---	---	.18	---
Tenderness Taste Panel Aged Roasts	---	---	---	.28

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

The Relationship Between Marbling and Ether Extract of the L. dorsi with Juiciness of Both Unaged and Aged Steaks and Roasts

The relationship between marbling and juiciness and ether extract of the *L. dorsi* and juiciness are presented in Table 22. Marbling score was associated with juiciness of unaged steaks as indicated by a correlation coefficient of .48 which was significant at the one per cent level. The relationship between marbling and juiciness of aged steaks was low and lacked significance. Juiciness of both unaged and aged roasts was significantly associated with marbling score; the correlations of .40 in each instance were significant at the one per cent level. Thus, it appears that a relationship exists between fatness and or marbling and juiciness in roasts when the two variables are measured subjectively.

Per cent ether extract of the *L. dorsi* had a correlation of .28 with juiciness of unaged steaks and lacked statistical significance. However, a correlation of .30 which was significant at the five per cent level was found between ether extract of the *L. dorsi* and juiciness of aged steaks. Per cent ether extract of the *L. dorsi* had a correlation of .31, which was significant at the five per cent level, with juiciness of unaged roasts. A highly significant correlation coefficient of .39 was found between ether extract of the *L. dorsi* and juiciness of aged roasts.

The Relationship of Juiciness and Tenderness

Correlation coefficients between juiciness and tenderness are presented in Table 22. An insignificant correlation coefficient of

-.13 was found between juiciness of unaged steaks and tenderness of unaged steaks. A correlation of .26, which lacked significance, was obtained between juiciness and tenderness of aged steaks. With juiciness and tenderness of unaged roasts, and insignificant correlation of .18 was found and a correlation of .28 which also lacked significance, was obtained between juiciness and tenderness of aged roasts. The lack of significance of correlations between juiciness and tenderness indicates the low degree of association between these variables.

The Relationship Between Cannon Bone Measurements and Measures of Meatiness in the Carcass

In this study, rib eye area, adjusted rib eye area, and separable lean of the 9-10-11 rib cut were used in estimating carcass meatiness. Table 23 shows the relationships between cannon bone measurements and meatiness.

Correlations between rib eye area and cannon bone length and width measurements lacked significance. However, correlations of .36 and .29 were found between rib eye area and metacarpus weight and depth and were significant at the five per cent level. Correlations of .37 and .35 were obtained between rib eye area and metatarsus weight and depth and were also significant at the five per cent level.

The coefficient of correlation between adjusted rib eye area and metacarpus weight was -.30. The correlation between adjusted rib eye area and metatarsus weight was -.35. These correlations were significant at the five per cent level. A highly significant correlation of -.41 was obtained between adjusted rib eye area and metatarsus depth. Correlation coefficients for metacarpus depth, length, and width and those for metatarsus length and width with adjusted rib eye area lacked significance.

TABLE 23

THE RELATIONSHIP BETWEEN CARCASS MEATINESS AS INDICATED BY RIB EYE AREA, ADJUSTED RIB EYE AREA, AND SEPARABLE LEAN OF THE 9-10-11 RIB CUT, AND METATARSUS AND METACARPUS WEIGHT, LENGTH, WIDTH, AND DEPTH

Source of Variation	Rib Eye Area	Adjusted Rib Eye Area	Separable Lean of the 9-10-11 Rib Cut
Metacarpus weight	.36*	-.30*	.02
Metacarpus length	.20	-.23	.08
Metacarpus width	.15	-.27	-.18
Metacarpus depth	.29*	-.21	.07
Metatarsus weight	.37*	-.35*	-.02
Metatarsus length	.16	-.19	.12
Metatarsus width	.23	-.26	-.11
Metatarsus depth	.35*	-.41**	-.06

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

Correlation coefficients between separable lean of the 9-10-11 rib cut and cannon bone weights and measures lacked significance as presented in Table 23.

The significant relationships between cannon bone measurements and rib eye area explain only a small percentage of the total variation.

The Effect of Breed Differences on Marbling, Carcass Grade, and Dressing Per Cent

It was considered feasible to determine whether or not performance differences due to breed differences existed in this study. A least squares analysis was employed since the sub-class numbers were unequal. The animals in the trial were divided into four breed groups by percentage of Brahman breeding. The four breed groups were: no Brahman breeding, one-fourth Brahman, one-half Brahman, and three-fourths or more Brahman. Performance by lot was considered as a non-continuous variable and winter gain and feed lot gain were incorporated as continuous variables using the covariance technique described by Hazel (1946). Three of the more important dependent variables of this study were used in the analysis; the variables were marbling scores, carcass grade, and dressing per cent.

Table 24 illustrates that breed had a definite effect on marbling. The difference between animals of no Brahman breeding and animals of three-fourths or more Brahman was significant at the five per cent level as was the difference between animals of one-half Brahman and three-fourths or more Brahman. A difference, significant at the one per cent level, was found between animals of one-fourth Brahman and

TABLE 24

EFFECTS OF BREED, LOT AND WEIGHT GAINS ON MARBLING, CARCASS GRADE AND DRESSING PER CENT AS REPRESENTED BY DEVIATIONS FROM ANIMALS WITH THREE-FOURTHS OR MORE BRAHMAN AND FROM LOT FOUR

Characteristic	Breed				Lot				Weight Gain	
	No Brahman	1/4 Brahman	1/2 Brahman	3/4 Brahman	Lot 1	Lot 2	Lot 3	Lot 4	Winter Gain	Feed Lot Gain
Marbling Score	1.768*	1.564**	1.068*	0	-1.664	-0.336	-0.770	0	-0.00003	0.00614
Carcass Grade	1.363	1.143*	0.352	0	-1.852*	-0.144	-0.856	0	0.00302	0.00986*
Dressing Per Cent	-1.590	-2.018**	0.206	0	-0.480	0.544	-0.470	0	0.02362**	0.00184

*Significant at the five per cent level of probability.

**Significant at the one per cent level of probability.

animals of three-fourths or more Brahman.

Lot differences in marbling were statistically insignificant when breed differences were taken out. Differences in weight gains as they affected marbling lacked significance. It therefore appears that marbling differences were more the effect of breed differences than either lot treatment or weight gains.

The effect of breed on carcass grade shown in Table 24 was not as pronounced as the effect of breed on marbling. Carcass grade differences between animals of one-fourth Brahman and animals of three-fourths or more Brahman were significant at the five per cent level. However, grade differences between animals of no Brahman breeding, one-half Brahman and three-fourths or more Brahman lacked significance.

Differences in carcass grade between Lot 1 and Lot 4 were significant at the five per cent level. The differences between Lots 2, 3, and 4 were not significant. Feed lot gain, as would be expected, affected carcass grade and was significant at the five per cent level. These data indicate that breed of animal, lot treatment, and feed lot gain affected carcass grade.

Table 24 indicates that animals of one-fourth Brahman breeding had a lower dressing percentage than animals of three-fourths or more Brahman. The difference was significant at the one per cent level. Differences between animals of no Brahman breeding, one-half Brahman, and three-fourths or more Brahman lacked significance. Lot differences in dressing per cent also lacked statistical significance when breed differences were taken out. Winter gain as a covariant, was significantly associated with dressing per cent at the one per cent level of probability. However, the relationship between feed lot gain and dressing per cent lacked significance.

Marbling score of all three of the breed groups with less than three-fourths Brahman breeding was significantly higher than the group with three-fourths or more Brahman breeding. The breed effect on marbling score was of such magnitude that lot differences were insignificant, indicating that breed affected marbling more than the wintering treatment.

Carcass grade differences due to breed were not as great as with marbling differences due to breed but all three of the breed groups with less than three-fourths Brahman breeding graded higher than the group with three-fourths or more Brahman. This difference may be explained by the higher degree of marbling of the other three breed groups. However, the only significant grade difference existed between animals of one-fourth Brahman and those of three-fourths or more Brahman. Table 24 shows that Lot 4 graded higher than the other three lots and significantly higher than Lot 1 which was severely restricted during wintering.

The animals with three-fourths or more Brahman breeding had significantly higher dressing percentages than the animals with one-fourth Brahman breeding.

Breed or per cent of Brahman breeding in animals and carcasses used in this study exerted an influence on marbling score, carcass grade and dressing per cent.

VI. SUMMARY

Forty-four weanling heifers were allotted by approximate breeding and weight into four equal lots. During the 119 day wintering period on Bahia grass pasture, supplementation consisted of citrus pulp and cottonseed meal (41 per cent) adjusted in quantity periodically to control rate of gain. Lot 1 animals averaged 0.06 pound daily gain; Lot 2, 0.45 pound; Lot 3, 0.82 pound; and Lot 4 animals averaged 1.11 pounds daily.

All lots were placed in feed lot and self-fed the same fattening ration for 140 days; average daily gains for Lots 1 through 4 respectively were 2.08 pounds, 2.29 pounds, 1.85 pounds, and 1.96 pounds. Pounds of feed lot ration required per hundred pounds of gain for Lots 1 through 4 were: 940, 978, 1,010, and 1,004. Coarsely chopped Pangola grass hay at the level of 1.44-1.49 pounds per animal daily was fed.

Differences between lots in slaughter characteristics such as per cent intransit shrink, per cent gastro-intestinal tract, per cent fill, and per cent caul and ruffle fat lacked statistical significance. When analyzed on within breed, within lot basis by a least squares analysis, lot differences in dressing per cent were insignificant. However, a definite breed effect was found, animals with one-fourth Brahman breeding had significantly lower dressing percentages, at the one per cent level, than animals with three-fourths or more Brahman.

The least squares analysis showed a pronounced breed effect on marbling; animals with no Brahman breeding and animals with one-half

Brahman had significantly more marbling at the five per cent level than animals with three-fourths or more Brahman breeding. The differences between animals with one-fourth Brahman and those with three-fourths or more Brahman breeding were significant at the one per cent level. In this study, breed differences exerted more influence on marbling than the wintering treatment.

Differences in carcass grade between Lots 1 and 4 were significant at the five per cent level. Differences in carcass grade between Lots 2, 3, and 4 lacked significance. Although animals with one-fourth Brahman breeding had significantly lower dressing percentages, they had significantly higher carcass grades because of a higher degree of marbling.

Lot differences in carcass measurements lacked significance with the exception of differences in circumference of round which were significant at the five per cent level of probability. There were no significant differences in rib eye area, adjusted rib eye area or separable lean of the 9-10-11 rib cut. However, physical separation of the 9-10-11 rib cut showed statistically significant differences between lots in per cent separable fat. Lot 4 had 38.6 per cent separable fat followed closely by Lot 2 with 37.6 per cent; Lots 1 and 3 had 33.3 and 33.9 per cent respectively. A highly significant difference was found in fat depth over the L. dorsi. Lots 1 through 4 had 0.54 inches, 0.74 inches, 0.62 inches, and 0.80 inches respectively.

Tenderness differences between lots in cooked steaks and roasts as tested by taste panel and Warner-Bratzler shear apparatus lacked significance.

The negative relationship obtained between winter gain and feed lot gain was insignificant. The associations between weight gains and per cent intransit shrink, per cent gastro-intestinal tract, per cent fill, and per cent caul and ruffle fat were very low. A highly significant correlation of .54 was found between winter gain and dressing per cent. The relationship between feed lot gain and dressing per cent lacked significance.

Marbling score was significantly associated with winter gain with a correlation of .31. A highly significant correlation of .44 was obtained between marbling and feed lot gain. A highly significant correlation of .38 was obtained between winter gain and carcass grade. A correlation of .48 was obtained between feed lot gain and carcass grade. Carcass measurements of carcass length, length of leg, circumference of round and chuck thickness were significantly associated with both winter and feed lot gain at the one per cent level of probability.

The positive association between separable fat of the 9-10-11 rib cut and winter gain was significant at the one per cent level of probability and the relationship between the separable fat of the rib cut and feed lot gain was significant at the five per cent level. Separable lean of the 9-10-11 rib cut had a significant negative correlation of -.36 with winter gain. The association with feed lot gain lacked significance.

Chemical determinations of moisture, ether extract, and protein of the 9-10-11 rib cut and of moisture and ether extract of the L. dorsi muscle indicated that the percentages of these constituents calculated was significantly associated with both winter and feed lot gain. Significant negative relationships between per cent moisture and protein with weight gains was found.

Correlation coefficients for tenderness of steaks and roasts with weight gains were generally low and lacked significance. Carcass grade and marbling score were not significantly associated with the tenderness of unaged or aged steaks. However, low but significant correlations were found between carcass grade and the tenderness of unaged roasts. Marbling score had low but significant correlations with tenderness of aged roasts. The relationship between per cent ether extract of the _L. dorsi_ and tenderness was closer than the relationship between tenderness and marbling score. A highly significant correlation of .40 was found between ether extract of the _L. dorsi_ and tenderness of aged steaks. Correlations between ether extract of the _L. dorsi_ and tenderness of unaged and aged roasts were also significant.

Highly significant correlations were found between metatarsus breaking strength and the tenderness of unaged and aged steaks and roasts. However, the highest correlation accounted for only 30.2 per cent of the total variation. Correlations between metacarpus breaking strength and tenderness were generally low and lacked significance with one exception.

Correlations between juiciness of steaks and roasts and winter gain lacked significance. A low but significant correlation was found between juiciness of unaged steaks and feed lot gain. Carcass grade was significantly associated with juiciness of unaged and aged steaks and roasts, although the highest correlation explained only 17.6 per cent of the total variation. Marbling score had highly significant correlations of .48, .40, and .40 with juiciness of unaged steaks, unaged roasts, and aged roasts respectively. Per cent ether extract of the L. dorsi had low but significant correlations with juiciness of aged steaks and unaged and aged roasts. Low, insignificant correlations were found between juiciness and tenderness.

Low, but significant, relationships were found between rib eye area and metacarpus weight, metatarsus weight, metacarpus depth, and metatarsus depth. Correlation coefficients which were significant at the five per cent level were obtained between adjusted rib eye area and metacarpus weight and metatarsus weight. A highly significant correlation of -.41 was found between adjusted rib eye area and metatarsus depth. Correlation coefficients between the cannon bone measurements and separable lean of the 9-10-11 rib cut lacked significance. The significant relationships found between bone measurements and estimators of carcass meatiness were too low for practical application.

APPENDIX

TABLE 25

WINTERING AND FEED LOT WEIGHT DATA

		Wintering			Feed Lot		
Lot No.	Animal No.	Initial Weight	Gain	Avg. Daily Gain	Initial Weight	Gain	Avg. Daily Gain
1	84	350	-20	-.17	330	305	2.18
1	X121	380	-35	-.29	345	230	1.64
1	294	415	10	.08	425	235	1.68
1	296	455	45	.38	500	310	2.21
1	301	470	- 5	-.04	465	305	2.18
1	308	440	45	.38	485	335	2.39
1	322	435	-20	-.17	415	365	2.61
1	324	355	5	.04	360	275	1.96
1	325	375	5	.04	380	390	2.78
1	340	370	30	.25	400	245	1.75
1	334	365	15	.13	380	205	1.46
2	96	355	30	.25	385	315	2.25
2	97	395	30	.25	425	325	2.32
2	205	315	35	.29	350	350	2.50
2	288	445	55	.46	500	375	2.68
2	293	490	125	1.05	615	360	2.57
2	315	440	60	.50	500	400	2.86
2	317	415	70	.59	485	340	2.43
2	323	345	30	.25	375	255	1.82
2	326	305	70	.59	375	305	2.18
2	337	310	55	.46	365	225	1.61
2	338	365	35	.29	400	275	1.96
3	87	400	85	.71	485	215	1.54
3	102	310	85	.71	395	175	1.25
3	104	380	75	.63	455	275	1.96
3	X124	355	75	.63	430	255	1.82
3	278	475	180	1.51	655	315	2.25
3	295	475	95	.80	570	240	1.71
3	303	420	90	.76	510	245	1.75
3	316	360	85	.71	445	225	1.61
3	319	380	135	1.13	515	295	2.11
3	335	345	90	.76	435	300	2.14
3	339	370	85	.71	455	305	2.18

TABLE 25--Continued

		Wintering			Feed Lot		
Lot No.	Animal No.	Initial Weight	Gain	Avg. Daily Gain	Initial Weight	Gain	Avg. Daily Gain
4	81	390	165	1.39	555	300	2.14
4	85	415	135	1.13	550	250	1.78
4	86	420	30	.25	450	310	2.21
4	91	385	35	.29	420	315	2.25
4	X119	370	135	1.13	505	210	1.50
4	271	455	120	1.00	575	310	2.21
4	272	425	165	1.39	590	305	2.18
4	300	415	210	1.76	625	320	2.28
4	304	350	125	1.05	475	245	1.75
4	321	475	155	1.30	630	165	1.18
4	333	365	175	1.47	540	285	2.04

TABLE 28

SLAUGHTER DATA

Lot No.	Animal No.	Slaugh. Weight	Chill Dressed Weight	Dressing Per Cent	Intran. Shrink	Per Cent G. I. Tract	Per Cent Fill	Per Cent Intest. Fat
1	84	600	330	55.0	5.5	10.8	4.4	2.6
1	X121	545	303	55.6	5.2	12.8	5.0	2.4
1	294	630	369	58.6	4.5	12.5	6.2	2.1
1	296	765	458	59.9	5.6	12.2	6.3	4.3
1	301	740	448	60.5	3.9	9.1	4.2	4.3
1	308	780	445	57.1	4.9	12.9	7.2	5.8
1	322	745	447	60.0	4.5	9.9	4.9	2.8
1	324	600	358	59.7	5.5	9.2	4.2	2.2
1	325	700	413	59.0	9.1	9.8	4.1	3.1
1	340	605	345	57.0	6.2	15.5	7.2	1.8
1	334	555	317	57.1	5.1	10.0	3.9	2.3
2	96	660	397	60.2	5.7	10.4	5.6	3.2
2	97	750	463	61.7	0.0	8.3	4.0	3.5
2	205	670	385	57.5	4.3	9.2	3.6	5.4
2	288	825	491	59.5	5.7	11.1	6.4	3.9
2	293	915	587	64.1	6.2	11.3	6.4	4.2
2	315	835	511	61.2	7.2	9.4	4.6	4.1
2	317	775	471	60.8	6.1	9.0	4.1	3.2
2	323	590	370	62.7	6.3	9.0	4.4	4.7
2	326	630	365	57.9	7.4	14.1	6.0	2.9
2	337	575	347	60.4	2.5	8.8	4.4	2.8
2	338	635	365	57.5	5.9	10.0	4.8	2.4
3	87	670	401	59.8	4.3	13.1	5.4	2.7
3	102	540	336	62.2	5.3	8.6	4.0	2.0
3	104	690	414	60.0	5.5	6.4	2.0	2.5
3	X124	650	378	58.2	4.4	10.1	5.5	3.8
3	278	905	533	58.9	6.7	8.0	2.3	3.6
3	295	765	478	62.6	5.6	11.5	5.6	2.9
3	303	705	436	61.8	6.6	11.9	5.5	3.1
3	316	620	382	61.6	7.5	7.8	2.7	2.7
3	319	750	442	58.9	7.4	12.0	6.4	4.4
3	335	695	411	59.1	5.4	11.0	5.7	2.7
3	339	710	428	60.3	6.6	10.5	5.3	3.1
4	81	800	497	62.1	6.4	8.4	3.8	2.6
4	85	755	461	61.1	5.6	8.3	3.3	2.4

TABLE 26 --Continued

Lot No.	Animal No.	Slaugh. Weight	Chill Dressed Weight	Dressing Per Cent	Intran. Shrink	Per Cent G. I. Tract	Per Cent Fill	Per Cent Intest. Fat
4	86	715	430	60.1	5.9	11.2	6.6	2.8
4	91	680	399	58.7	7.5	10.9	5.7	2.9
4	X119	670	420	62.7	6.3	8.4	3.9	2.7
4	271	835	508	60.8	5.6	11.1	6.0	5.4
4	272	845	532	63.0	5.6	10.3	5.3	4.3
4	300	890	564	63.4	5.8	8.1	4.2	1.6
4	304	670	412	61.5	6.9	15.2	8.0	5.7
4	321	775	485	62.6	2.5	8.4	4.8	5.5
4	333	775	468	60.4	6.1	11.4	5.5	4.0

TABLE 27

CARCASS MEASUREMENTS

Lot No.	Animal No.	Carcass Length	Length of Leg	Circum. Round	Chuck Thick	Area L. Dorsi	Depth of Fat over Ribeye
1	84	41.8	25.8	25.0	6.3	6.60	.34
1	X121	40.1	26.5	26.1	5.1	7.20	.24
1	294	42.3	28.8	25.6	5.4	7.00	.77
1	296	44.6	28.8	29.3	6.1	8.02	.40
1	301	44.5	28.9	27.1	5.5	7.82	.57
1	308	45.1	28.0	28.8	6.3	7.73	.64
1	322	44.3	29.0	27.8	5.5	9.31	.84
1	324	40.8	28.8	26.6	5.6	7.96	.64
1	325	42.5	28.5	28.4	5.8	9.06	.70
1	340	42.5	28.0	25.6	5.1	6.40	.57
1	334	41.3	28.5	25.5	4.9	6.35	.27
2	96	41.3	27.8	27.3	5.8	7.33	1.10
2	97	42.0	28.8	29.9	6.0	8.45	.97
2	205	41.9	26.8	28.1	6.0	8.01	.54
2	288	45.0	29.5	29.8	5.9	8.21	.74
2	293	46.5	29.0	33.3	7.5	9.73	.87
2	315	45.6	30.0	21.8	6.1	9.13	.67
2	317	43.0	28.5	28.3	6.0	8.19	.80
2	323	41.0	27.5	26.8	5.9	8.33	.50
2	326	42.0	26.5	27.4	6.3	7.04	.54
2	337	40.5	28.3	27.3	5.5	6.56	.64
2	338	42.5	28.8	27.0	5.6	6.98	.80
3	87	44.0	31.3	26.8	4.8	7.06	.34
3	102	39.0	27.3	26.5	5.8	8.13	.67
3	104	42.8	28.0	28.3	5.9	8.69	.60
3	X124	41.8	26.3	30.0	5.5	6.87	.60
3	278	47.0	30.0	32.4	6.1	7.66	.64
3	295	43.5	29.3	29.0	6.3	8.57	.64
3	303	43.3	28.3	28.0	5.9	7.80	.97
3	316	43.0	28.8	27.3	5.3	7.86	.74
3	319	43.8	28.3	29.0	6.3	7.50	.54
3	335	42.8	28.0	28.6	5.9	8.27	.74
3	339	44.1	30.3	30.4	5.6	7.56	.54
4	81	45.0	30.3	30.0	5.8	8.37	.84
4	85	44.5	29.8	28.5	5.8	7.88	.87
4	86	42.5	29.6	27.0	5.6	8.34	.57
4	91	42.3	28.3	28.0	6.0	6.95	.87

TABLE 27—Continued

Lot No.	Animal No.	Carcass Length	Length of Leg	Circum. Round	Chuck Thick.	Area *L. Dorsi*	Depth of Fat over Ribeye
4	X119	42.3	29.0	27.3	5.1	8.94	.60
4	271	44.3	28.8	30.5	5.9	9.30	.70
4	272	45.5	28.0	29.3	6.6	7.59	1.07
4	300	46.5	28.0	33.0	7.4	7.96	.94
4	304	42.8	27.8	28.3	6.0	7.68	.74
4	321	45.3	30.0	26.8	5.6	8.62	.80
4	333	44.1	28.3	31.3	6.3	7.23	.77

TABLE 28

CARCASS GRADE AND CANNON BONE BREAKING STRENGTH DATA

Lot No.	Animal No.	Carcass Confor.	Outside Finish	Inside Quality	Marbling Score	Carcass Grade	Breaking Strength (Lbs.)	
							Meta-tarsus	Meta-carpus
1	84	14	16	15	5	15	2073	1640
1	X121	12	12	11	2	11	3965	1538
1	294	13	14	13	2	12	2615	2260
1	296	13	17	17	5	14	2783	1985
1	301	13	15	15	4	13	2785	2593
1	308	13	17	17	5	14	2888	2203
1	322	13	14	14	3	12	3403	2635
1	324	12	13	11	2	12	2483	2303
1	325	11	13	13	3	12	3525	2990
1	340	13	14	13	2	12	2870	2265
1	334	12	12	12	3	12	2090	2045
2	96	16	18	17	5	15	2723	2190
2	97	16	17	16	5	16	2925	2370
2	205	14	17	15	4	14	2875	2700
2	288	16	17	17	5	16	3125	2750
2	293	17	17	15	7	17	3008	2450
2	315	16	17	17	6	16	3490	2930
2	317	16	17	16	4	14	3403	2198
2	323	16	17	17	7	16	2150	2015
2	326	14	15	15	5	14	2450	2018
2	337	14	14	14	3	13	2733	2165
2	338	13	17	14	2	12	2934	2409
3	87	11	13	13	2	11	2670	2407
3	102	14	14	14	3	13	2448	2285
3	104	15	14	13	3	13	3240	3263
3	X124	14	17	16	5	14	2503	1813
3	278	16	18	16	5	16	2958	2483
3	295	13	18	14	4	13	3155	2480
3	303	14	18	15	4	14	2650	2228
3	316	13	15	12	2	12	2595	1993
3	319	13	15	15	5	15	3100	2435
3	335	13	15	15	4	13	3023	2947
3	339	14	14	15	4	14	3030	2675

TABLE 28--Continued

Lot No.	Animal No.	Carcass Confor.	Outside Finish	Inside Quality	Marbling Score	Carcass Grade	Breaking Strength (Lbs.)	
							Meta-tarsus	Meta-carpus
4	81	15	17	13	3	13	3525	2945
4	85	14	17	15	4	14	3835	3073
4	86	14	17	15	4	14	3150	2488
4	91	16	17	17	5	16	3023	2680
4	X119	15	15	12	2	13	2905	2300
4	271	17	17	17	7	16	3258	2320
4	272	17	20	17	7	17	2755	2358
4	300	17	17	17	6	17	2798	2458
4	304	14	16	15	4	13	2860	2560
4	321	14	17	16	5	14	3540	2998
4	333	13	17	15	4	14	2778	2173

TABLE 29

TENDERNESS DATA

Lot No.	Animal No.	Unaged Steaks		Aged Steaks		Unaged Roasts		Aged Roasts	
		Panel	Shear	Panel	Shear	Panel	Shear	Panel	Shear
1	84	5.00	10.0	5.00	9.5	5.75	8.1	6.00	7.3
1	X121	2.00	19.8	3.13	17.4	2.50	16.7	4.50	14.0
1	294	5.25	8.2	4.80	9.8	5.75	8.3	4.75	10.6
1	296	3.75	11.0	4.88	11.9	5.25	10.4	6.00	9.0
1	301	5.00	10.9	5.75	8.6	5.25	10.4	5.75	10.8
1	308	4.25	11.3	5.50	9.4	5.75	7.9	6.00	8.1
1	322	3.63	10.7	4.50	9.7	4.50	10.6	4.75	11.2
1	324	2.38	10.6	3.88	9.3	5.00	9.2	5.25	8.8
1	325	2.75	11.7	3.75	11.2	4.00	11.2	5.00	10.1
1	340	3.25	14.1	4.63	10.5	6.00	8.6	5.50	8.4
1	334	3.88	12.0	4.88	10.4	4.75	12.1	4.75	9.0
2	96	3.50	10.4	4.13	12.0	4.50	11.5	4.75	8.5
2	97	2.25	10.3	3.88	11.6	5.00	8.8	4.75	8.8
2	205	2.50	15.0	3.88	14.4	4.75	10.2	5.00	10.9
2	288	3.25	9.8	4.63	10.3	5.25	11.6	5.00	9.8
2	293	3.75	9.4	5.00	9.0	5.00	9.6	6.00	8.0
2	315	4.13	9.6	4.38	9.6	4.75	8.8	4.75	9.0
2	317	3.13	12.2	3.88	11.6	3.50	12.0	4.00	14.3
2	323	5.00	8.7	5.75	8.3	5.50	8.7	6.00	8.2
2	326	3.88	9.9	4.25	11.9	4.50	12.6	5.50	10.2
2	337	5.63	8.6	6.00	6.6	5.25	10.2	5.25	10.2
2	338	4.88	9.4	5.25	10.2	5.50	9.9	5.75	9.1
3	87	4.63	9.6	5.75	7.4	4.75	8.8	5.75	7.4
3	102	4.13	8.2	5.38	7.7	4.25	10.2	5.50	8.8
3	104	3.75	13.3	3.75	14.0	4.00	11.0	3.75	12.8
3	X124	3.50	11.4	5.50	9.1	5.00	11.6	5.50	9.2
3	278	4.13	11.6	5.88	8.1	4.25	9.9	5.25	9.3
3	295	3.88	10.0	5.00	9.8	4.50	10.0	4.75	9.4
3	303	5.63	8.6	5.88	8.9	5.25	10.6	6.00	7.3
3	316	3.75	11.2	3.88	11.7	3.75	11.6	4.75	10.1
3	319	4.13	11.7	4.88	11.0	4.25	11.0	5.75	10.4
3	335	3.75	10.1	4.75	11.2	3.50	11.8	5.00	9.4
3	339	3.38	11.2	4.63	9.5	4.75	11.6	5.00	9.2
4	81	4.63	9.1	5.13	8.2	4.50	9.6	5.75	7.0
4	85	2.88	11.6	2.75	12.8	2.25	13.1	3.75	13.2
4	86	4.25	9.5	5.25	8.9	5.50	8.9	5.25	9.5

TABLE 29 --Continued

Lot No.	Animal No.	Unaged Steaks		Aged Steaks		Unaged Roasts		Aged Roasts	
		Panel	Shear	Panel	Shear	Panel	Shear	Panel	Shear
4	91	5.50	7.6	4.50	9.2	5.50	8.4	6.00	8.1
4	X119	4.00	11.0	4.50	10.5	3.75	14.2	5.00	9.8
4	271	4.50	10.7	4.50	10.3	5.00	10.9	5.75	7.1
4	272	3.25	12.4	5.13	10.7	5.25	8.8	5.50	8.4
4	300	4.38	10.7	5.50	8.1	6.00	7.5	5.75	8.1
4	304	2.63	14.4	5.00	9.8	4.25	10.2	5.50	9.3
4	321	2.75	13.0	3.75	12.7	4.25	12.5	3.75	9.6
4	333	5.13	9.7	5.13	9.6	4.75	9.1	5.50	8.5

TABLE 30

JUICINESS EVALUATIONS AND CHEMICAL ANALYSIS OF THE *L. DORSI*

		Juiciness				L. Dorsi Chem. Analysis	
Lot No.	Animal No.	Unaged Steaks	Aged Steaks	Unaged Roasts	Aged Roasts	Per Cent Moisture	Per Cent Ether Extract
1	84	4.50	4.90	5.50	5.25	71.5	5.2
1	X121	4.25	2.40	4.00	3.75	74.5	1.5
1	294	4.13	3.75	5.25	4.75	73.4	1.8
1	296	4.38	4.25	5.25	4.25	71.4	4.1
1	301	4.38	4.75	4.75	4.25	70.8	4.4
1	308	4.75	4.75	5.00	5.75	70.1	5.6
1	322	4.50	4.25	5.25	4.00	72.8	2.0
1	324	4.50	5.75	3.75	5.25	73.5	1.3
1	325	5.00	3.88	4.25	6.00	72.7	3.8
1	340	4.63	4.33	3.25	3.50	73.9	1.6
1	334	4.38	3.63	4.00	4.50	74.4	1.0
2	96	4.63	4.13	5.00	4.50	72.0	3.0
2	97	5.25	4.25	5.50	4.75	74.1	1.8
2	205	5.38	3.88	5.00	5.00	72.6	2.3
2	288	4.63	4.63	5.00	4.75	71.7	3.4
2	293	5.38	5.13	5.00	5.50	71.9	4.9
2	315	5.25	4.63	5.50	4.50	71.6	3.5
2	317	5.13	4.63	4.50	4.00	72.2	2.6
2	323	5.63	4.75	5.00	5.00	71.9	5.6
2	326	5.63	4.38	4.75	5.00	74.1	3.9
2	337	3.88	5.00	4.75	5.00	73.8	1.6
2	338	4.25	3.80	5.00	4.75	74.0	1.2
3	87	4.38	3.88	4.75	4.75	72.8	2.1
3	102	5.38	4.88	4.75	4.25	73.4	2.8
3	104	4.00	4.38	5.75	4.00	72.9	2.4
3	X124	3.75	4.63	5.75	4.75	72.1	3.9
3	278	5.25	5.63	4.25	4.25	70.9	4.5
3	295	5.25	3.50	5.75	5.25	73.1	2.7
3	303	5.13	4.50	5.25	5.00	70.3	5.5
3	316	4.00	4.63	4.00	4.25	72.9	2.8
3	319	4.38	4.75	4.75	5.00	70.3	5.1
3	335	5.25	4.38	3.50	4.75	72.7	2.7
3	339	5.00	4.25	4.50	5.00	71.9	2.7

TABLE 30--Continued

		Juiciness				L. Dorsi Chem. Analysis	
Lot No.	Animal No.	Unaged Steaks	Aged Steaks	Unaged Roasts	Aged Roasts	Per Cent Moisture	Per Cent Ether Extract
4	81	4.38	4.38	5.00	5.00	71.9	2.2
4	85	4.50	4.75	5.50	4.50	72.5	2.5
4	86	4.63	3.63	5.00	5.50	73.9	2.7
4	91	5.00	3.88	4.50	4.50	71.6	3.6
4	X119	3.88	4.50	4.50	4.25	73.4	1.4
4	271	4.88	4.38	5.00	5.75	71.4	3.9
4	272	4.88	3.88	5.00	4.75	69.9	6.6
4	300	4.25	4.63	5.50	5.50	69.5	7.7
4	304	4.13	4.38	5.00	5.25	72.0	3.3
4	321	5.25	4.38	5.25	5.75	72.5	3.2
4	333	4.13	4.75	5.75	5.00	72.1	3.0

TABLE 31

PHYSICAL SEPARATION OF THE 9-10-11 RIB CUT AND CHEMICAL ANALYSIS OF THE SAME CUT

		9-10-11 Rib Cut Physical Separation				9-10-11 Rib Cut Chemical Analysis		
Lot No.	Animal No.	Per Cent Fat	Per Cent Lean	Per Cent Bone	Per Cent C. T.	Per Cent Moisture	Per Cent Ether Extract	Per Cent Protein
1	84	34.8	47.8	16.3	1.08	45.2	40.9	14.2
1	X121	25.6	55.1	21.8	2.56	54.9	27.7	17.5
1	294	32.2	50.0	17.8	1.11	50.2	34.7	14.7
1	296	38.0	43.5	17.6	0.92	44.5	40.9	14.0
1	301	41.3	42.9	15.1	0.79	40.3	46.2	12.9
1	308	44.1	40.7	15.2	1.69	41.6	44.7	13.8
1	322	30.8	54.2	14.0	0.93	50.3	34.3	15.2
1	324	29.8	54.2	14.9	1.06	53.2	29.9	16.0
1	325	30.8	51.3	17.1	0.85	50.4	33.2	16.4
1	340	32.1	48.8	17.8	1.19	50.8	33.3	15.8
1	334	26.8	50.0	19.5	3.65	54.5	28.2	17.0
2	96	37.5	43.3	18.3	0.96	43.7	42.5	14.1
2	97	41.0	44.4	13.2	1.38	42.9	45.1	13.0
2	205	38.7	44.3	17.0	0.94	45.8	38.9	14.4
2	288	39.2	46.2	13.8	1.53	44.8	40.8	13.8
2	293	39.5	45.2	12.1	1.91	45.5	40.8	13.6
2	315	32.1	53.4	14.5	0.76	47.6	37.0	15.6
2	317	41.2	43.7	14.3	0.84	45.3	40.4	13.7
2	323	40.4	46.5	12.3	0.87	43.2	43.8	13.6
2	326	31.6	50.0	17.3	2.04	47.6	38.1	14.4
2	337	37.4	45.4	16.2	1.01	47.0	38.6	14.3
2	338	34.4	45.2	18.3	1.07	47.9	37.9	14.7
3	87	29.2	50.0	18.8	2.08	53.6	29.4	17.6
3	102	30.3	51.7	15.7	2.24	53.0	31.0	16.0
3	104	34.2	48.1	15.7	1.85	49.1	35.9	14.9
3	X124	37.5	44.8	17.7	2.08	45.9	38.7	14.6
3	278	43.6	40.7	14.3	0.71	40.7	46.2	12.8
3	295	32.2	53.9	13.0	0.86	48.2	36.8	14.6
3	303	35.8	48.1	15.1	0.94	46.6	39.2	14.2
3	316	31.6	49.0	15.3	4.08	49.1	35.0	15.7
3	319	40.0	45.4	14.5	0.90	42.0	44.2	13.2
3	335	26.1	56.8	16.2	0.90	55.2	27.5	16.7
3	339	31.7	47.5	18.8	1.98	49.5	34.5	15.4

TABLE 31 —Continued

		9-10-11 Rib Cut Physical Separation				9-10-11 Rib Cut Chemical Analysis		
Lot No.	Animal No.	Per Cent Fat	Per Cent Lean	Per Cent Bone	Per Cent C. T.	Per Cent Moisture	Per Cent Ether Extract	Per Cent Protein
4	81	40.0	40.7	16.3	2.96	43.5	42.9	13.9
4	85	32.4	48.6	18.0	0.90	51.4	32.8	14.9
4	86	34.8	47.3	17.8	0.89	44.3	41.9	14.1
4	91	37.5	45.4	17.0	1.13	46.2	39.7	13.7
4	X119	29.8	53.8	16.3	0.96	50.0	33.7	15.7
4	271	38.3	46.7	14.2	0.83	43.4	42.7	13.9
4	272	49.6	37.2	13.1	0.68	35.8	53.6	10.4
4	300	47.7	37.2	14.4	1.30	38.1	50.6	11.0
4	304	37.8	46.8	14.4	0.90	46.6	39.2	13.8
4	321	40.3	44.8	14.9	0.74	43.6	42.7	13.8
4	333	36.1	47.1	16.0	0.84	45.2	37.6	14.4

TABLE 32

CANNON BONE MEASUREMENT DATA

Lot No.	Animal No.	Metacarpus Measurements Weight (gm)	Length (cm)	Width (cm)	Depth (cm)	Metatarsus Measurements Weight (gm)	Length (cm)	Width (cm)	Depth (cm)
1	84	227	18.7	3.1	2.2	265	21.3	2.7	2.6
1	X121	233	19.4	3.2	2.2	301	22.4	2.8	2.6
1	294	322	22.5	3.2	2.3	366	25.3	2.9	2.7
1	296	312	21.0	3.3	2.5	388	24.1	2.9	2.9
1	301	303	22.0	3.3	2.3	373	25.3	3.0	2.7
1	308	300	20.3	3.4	2.4	359	23.5	2.8	2.9
1	322	326	22.2	3.3	2.3	397	25.2	2.7	2.8
1	324	302	21.4	3.3	2.3	352	24.4	2.8	2.8
1	325	379	21.5	3.7	2.5	413	23.9	3.3	3.0
1	340	314	21.2	3.4	2.3	356	24.3	3.0	2.8
1	334	268	20.3	3.1	2.3	308	23.4	2.7	2.7
2	96	288	20.5	3.2	2.3	344	23.4	2.8	2.8
2	97	303	21.3	3.3	2.3	368	24.7	2.9	2.8
2	205	320	20.6	3.3	2.3	316	23.0	2.8	2.8
2	286	365	22.0	3.4	2.5	424	25.1	3.0	2.9
2	293	320	20.2	3.4	2.4	364	22.7	3.0	2.8
2	315	359	21.9	3.5	2.5	422	24.8	3.0	3.0
2	317	281	20.4	3.3	2.4	374	23.5	2.9	2.9
2	323	228	19.6	2.8	2.1	275	22.6	2.6	2.5
2	326	309	21.0	3.3	2.4	368	24.1	2.9	2.8
2	337	265	20.7	3.1	2.3	334	23.8	2.8	2.6
2	338	314	21.3	3.5	2.4	383	24.5	3.2	2.7
3	87	357	22.8	3.3	2.4	422	26.2	3.0	2.9
3	102	283	20.7	3.1	2.3	337	23.8	2.8	2.6
3	104	349	21.5	3.5	2.5	420	24.5	3.1	2.9
3	X124	263	20.3	3.3	2.3	336	23.4	2.8	2.8
3	278	371	22.1	3.7	2.5	426	24.9	3.2	3.0
3	295	309	21.2	2.4	2.4	376	24.6	3.0	2.9
3	303	254	19.8	3.2	2.2	316	23.5	2.7	2.7
3	316	264	20.2	3.2	2.6	333	23.6	3.1	2.5
3	319	275	19.9	3.2	2.3	331	22.7	2.8	2.7
3	335	335	21.1	3.5	2.7	374	24.1	2.9	3.0
3	339	344	21.3	3.4	2.5	421	24.6	3.1	2.9
4	81	366	22.5	3.5	2.5	433	25.6	3.3	2.9
4	85	390	22.5	3.6	2.5	445	25.7	3.1	3.0
4	86	347	22.1	3.5	2.5	422	25.2	3.3	2.9

TABLE 32--Continued

Lot No.	Animal No.	Metacarpus Measurements Weight (gm)	Length (cm)	Width (cm)	Depth (cm)	Metatarsus Measurments Weight (gm)	Length (cm)	Width (cm)	Depth (cm)
4	91	322	21.2	3.4	2.4	390	24.3	3.2	2.9
4	X119	316	21.2	3.4	2.4	371	24.4	3.0	2.7
4	271	293	20.4	3.4	2.3	379	23.5	3.1	2.9
4	272	289	20.7	3.3	2.3	355	23.4	2.9	2.8
4	300	309	20.5	3.4	2.4	349	22.9	2.9	2.8
4	304	276	20.2	3.0	2.4	316	23.1	2.7	2.6
4	321	328	21.7	3.4	2.4	402	25.3	3.0	2.9
4	333	328	21.4	3.6	2.4	392	24.4	3.1	2.8

TABLE 33

SUMMARY OF MEANS AND STANDARD DEVIATIONS OF CORRELATION COEFFICIENTS

Source of Variation	Mean	Standard Deviation
Wintering Avg. Daily Gain	0.64	0.45
Feed Lot Avg. Daily Gain	2.04	0.39
Per Cent Intransit Shrink	5.61	1.49
Per Cent Gastro-Intestinal Tract	10.41	3.62
Per Cent Fill	3.35	1.28
Dressing Per Cent	60.06	2.07
Carcass Grade	13.89	1.63
Carcass Conformation	14.16	1.59
Outside Finish	15.86	1.80
Inside Quality	14.80	1.70
Marbling Score	4.11	1.46
Carcass Length	43.21	1.77
Length of Leg	28.52	1.12
Circumference of Round	28.30	1.89
Chuck Thickness	5.86	0.53
Rib Eye Area	7.88	0.81
Adjusted Rib Eye Area	1.86	0.23
Depth of Fat Over Rib Eye	0.68	0.20
Per Cent Separable Fat 9-10-11 Rib Cut	35.32	5.41
Per Cent Separable Lean 9-10-11 Rib Cut	47.23	4.50
Per Cent Separable Bone 9-10-11 Rib Cut	15.96	2.04
Per Cent Separable Connective Tissue Rib Cut	1.36	0.78
Per Cent Chemical Moisture _L. dorsi_	72.35	1.25
Per Cent Ether Extract _L. dorsi_	3.28	1.51
Per Cent Protein 9-10-11 Rib Cut	14.50	1.43
Per Cent Ether Extract 9-10-11 Rib Cut	38.50	5.81
Per Cent Moisture 9-10-11 Rib Cut	46.78	4.40
Taste Panel Values, Unaged Steaks	3.90	0.92
Shear Values, Unaged Steaks	10.92	2.12
Taste Panel Values, Aged Steaks	4.73	0.75
Shear Values, Aged Steaks	10.29	1.99
Taste Panel Values, Unaged Roasts	4.71	0.82
Shear Values, Unaged Roasts	10.43	1.77
Taste Panel Values, Aged Roasts	5.22	0.63
Shear Values, Aged Roasts	9.46	1.66
Juiciness Values, Unaged Steaks	4.68	0.51
Juiciness Values, Aged Steaks	4.38	0.56
Juiciness Values, Unaged Roasts	4.87	0.59
Juiciness Values, Aged Roasts	4.80	0.56

TABLE 33--Continued

Source of Variation	Mean	Standard Deviation
Breaking Strength, Metacarpus	2409.41	3.71
Breaking Strength, Metatarsus	2934.00	4.15
Metacarpus Weight	309.23	3.93
Metacarpus Length	21.03	0.90
Metacarpus Width	3.31	0.22
Metacarpus Depth	2.38	0.11
Metatarsus Weight	368.09	4.26
Metatarsus Length	24.07	1.00
Metatarsus Width	2.94	0.18
Metatarsus Depth	2.80	0.13

TABLE 34

ANALYSIS OF VARIANCE OF AVERAGE DAILY GAINS (WINTERING)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	4348.71	319.46
Treatment	3	683.49	227.83
Error	40	3665.22	91.63

TABLE 35

ANALYSIS OF VARIANCE OF AVERAGE DAILY GAINS (FEEDLOT)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	664.53	53.07
Treatment	3	118.24	39.41*
Error	40	546.28	13.66

*Significant at the five per cent level of probability.

TABLE 36

ANALYSIS OF VARIANCE OF PER CENT INTRANSIT SHRINK

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	98.26	3.62
Treatment	3	3.77	1.26
Error	40	94.49	2.36

TABLE 37

ANALYSIS OF VARIANCE OF MARBLING SCORE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	94.00	7.60
Treatment	3	17.00	5.67*
Error	40	77.00	1.93

*Significant at the five per cent level of probability.

TABLE 38

ANALYSIS OF VARIANCE OF DRESSING PER CENT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	189.44	24.68
Treatment	3	64.69	21.56**
Error	40	124.75	3.11

**Significant at the one per cent level of probability.

TABLE 39

ANALYSIS OF VARIANCE OF CARCASS GRADE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	116.00	13.68
Treatment	3	35.00	11.66**
Error	40	81.00	2.02

**Significant at the one per cent level of probability.

TABLE 40

ANALYSIS OF VARIANCE OF CARCASS CONFORMATION

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	112.00	18.83
Treatment	3	52.00	17.33**
Error	40	60.00	1.50

**Significant at the one per cent level of probability.

TABLE 41

ANALYSIS OF VARIANCE OF CARCASS OUTSIDE FINISH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	143.00	19.00
Treatment	3	50.00	16.67**
Error	40	93.00	2.33

**Significant at the one per cent level of probability.

TABLE 42

ANALYSIS OF VARIANCE OF CARCASS INSIDE QUALITY

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	127.00	11.50
Treatment	3	27.00	9.00*
Error	40	100.00	2.50

*Significant at the five per cent level of probability.

TABLE 43

ANALYSIS OF VARIANCE OF CARCASS LENGTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	1380.40	74.38
Treatment	3	129.30	43.10
Error	40	1251.10	31.28

TABLE 44

ANALYSIS OF VARIANCE OF LENGTH OF LEG

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	552.70	26.19
Treatment	3	40.10	13.37
Error	40	512.60	12.82

TABLE 45

ANALYSIS OF VARIANCE OF CIRCUMFERENCE OF ROUND

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	1574.90	135.76
Treatment	3	312.60	104.20*
Error	40	1262.30	31.56

*Significant at the five per cent level of probability.

TABLE 46

ANALYSIS OF VARIANCE OF CHUCK THICKNESS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	122.30	7.71
Treatment	3	15.10	5.03
Error	40	107.20	2.68

TABLE 47

ANALYSIS OF VARIANCE OF AREA OF L. DORSI

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	28.56	1.18
Treatment	3	1.52	.50
Error	40	27.04	.68

TABLE 48

ANALYSIS OF VARIANCE OF PER CENT MOISTURE L. DORSI

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	69.05	3.45
Treatment	3	5.60	1.87
Error	40	63.45	1.58

TABLE 49

ANALYSIS OF VARIANCE OF PER CENT FAT L. DORSI

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	100.01	3.53
Treatment	3	3.34	1.11
Error	40	96.67	2.42

TABLE 50

ANALYSIS OF VARIANCE OF PER CENT CHEMICAL FAT 9-10-11 RIB CUT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	1487.56	123.23
Treatment	3	279.07	93.02*
Error	40	1208.49	30.21

*Significant at the five per cent level of probability.

TABLE 51

ANALYSIS OF VARIANCE OF PER CENT CHEMICAL MOISTURE 9-10-11 RIB CUT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	8510.50	67.88
Treatment	3	1511.30	50.38*
Error	40	6999.20	17.50

*Significant at the five per cent level of probability.

TABLE 52

ANALYSIS OF VARIANCE OF PER CENT CHEMICAL PROTEIN 9-10-11 RIB CUT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	90.31	8.44
Treatment	3	20.05	6.68*
Error	40	70.26	1.76

*Significant at the five per cent level of probability.

TABLE 53

ANALYSIS OF VARIANCE OF PER CENT BONE 9-10-11 RIB CUT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	184.07	10.65
Treatment	3	19.61	6.54
Error	40	164.46	4.11

TABLE 54

ANALYSIS OF VARIANCE OF PER CENT C. T. 9-10-11 RIB CUT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	26.72	1.40
Treatment	3	2.36	.79
Error	40	24.36	.61

TABLE 55

ANALYSIS OF VARIANCE OF PER CENT SEPARABLE FAT 9-10-11 RIB CUT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	1285.85	102.75
Treatment	3	229.00	76.33*
Error	40	1056.85	26.42

*Significant at five per cent level of probability.

TABLE 56

ANALYSIS OF VARIANCE OF PER CENT LEAN 9-10-11 RIB CUT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	889.84	59.84
Treatment	3	121.94	40.64
Error	40	767.90	19.20

TABLE 57

ANALYSIS OF VARIANCE OF FAT DEPTH FOR OVER *L. DORSI*

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	1.74	1.76
Treatment	3	.43	1.43**
Error	40	1.31	.33

**Significant at the one per cent level of probability.

TABLE 58

ANALYSIS OF VARIANCE OF TASTE PANEL VALUES OF UNAGED STEAKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	37.13	1.16
Treatment	3	.74	.25
Error	40	36.39	.91

TABLE 59

ANALYSIS OF VARIANCE OF SHEAR VALUES FOR UNAGED STEAKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	197.46	9.42
Treatment	3	14.55	4.85
Error	40	182.91	4.57

TABLE 60

ANALYSIS OF VARIANCE OF TASTE PANEL VALUES FOR AGED STEAKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	24.89	1.02
Treatment	3	1.28	.43
Error	40	23.61	.59

TABLE 61

ANALYSIS OF VARIANCE OF SHEAR VALUES FOR AGED STEAKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	174.73	5.94
Treatment	3	5.11	1.70
Error	40	169.62	4.24

TABLE 62

ANALYSIS OF VARIANCE OF TASTE PANEL VALUES FOR UNAGED ROASTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	29.24	1.30
Treatment	3	2.13	.71
Error	40	27.11	.68

TABLE 63

ANALYSIS OF VARIANCE OF SHEAR VALUES FOR UNAGED ROASTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	138.61	3.91
Treatment	3	1.43	.48
Error	40	137.18	3.43

TABLE 64

ANALYSIS OF VARIANCE OF TASTE PANEL VALUES FOR AGED ROASTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	17.32	.47
Treatment	3	.12	.04
Error	40	17.20	.43

TABLE 65

ANALYSIS OF VARIANCE OF SHEAR VALUES FOR AGED ROASTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	121.08	4.42
Treatment	3	4.52	1.51
Error	40	116.56	2.91

TABLE 66

ANALYSIS OF VARIANCE OF JUICINESS PANEL VALUES FOR UNAGED STEAKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	11.23	.83
Treatment	3	1.78	.59
Error	40	9.45	.24

TABLE 67

ANALYSIS OF VARIANCE OF JUICINESS PANEL VALUES FOR AGED STEAKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	14.07	.50
Treatment	3	.49	.16
Error	40	13.58	.34

TABLE 68

ANALYSIS OF VARIANCE OF JUICINESS PANEL VALUES FOR UNAGED ROASTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	15.43	.92
Treatment	3	1.75	.58
Error	40	13.68	.34

TABLE 69

ANALYSIS OF VARIANCE OF JUICINESS PANEL VALUES FOR AGED ROASTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	13.78	.72
Treatment	3	1.23	.41
Error	40	12.55	.31

TABLE 70

ANALYSIS OF VARIANCE OF METACARPUS WEIGHT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	67984.00	2882.68
Treatment	3	3837.00	1279.00
Error	40	64147.00	1603.68

TABLE 71

ANALYSIS OF VARIANCE OF METACARPUS LENGTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	358.70	12.79
Treatment	3	12.40	4.13
Error	40	346.30	8.66

TABLE 72

ANALYSIS OF VARIANCE OF METACARPUS WIDTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	22.00	1.01
Treatment	3	1.50	0.50
Error	40	20.50	0.51

TABLE 73

ANALYSIS OF VARIANCE OF METACARPUS DEPTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	5.70	0.36
Treatment	3	0.70	0.23
Error	40	5.00	0.13

TABLE 74

ANALYSIS OF VARIANCE OF METATARSUS WEIGHT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	79714.00	4208.53
Treatment	3	7186.00	2395.33
Error	40	72528.00	1813.20

TABLE 75

ANALYSIS OF VARIANCE OF METATARSUS LENGTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	440.00	16.58
Treatment	3	18.10	6.03
Error	40	421.90	10.55

TABLE 76

ANALYSIS OF VARIANCE OF METATARSUS WIDTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	13.70	0.99
Treatment	3	2.10	0.70
Error	40	11.60	0.29

TABLE 77

ANALYSIS OF VARIANCE OF METATARSUS DEPTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	7.80	0.29
Treatment	3	0.30	0.10
Error	40	7.50	0.19

TABLE 78

ANALYSIS OF VARIANCE OF METACARPUS BREAKING STRENGTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	6052837.00	374416.02
Treatment	3	723593.00	241197.67
Error	40	5328734.00	133218.35

TABLE 79

ANALYSIS OF VARIANCE OF PER CENT METATARSUS BREAKING STRENGTH

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	7594723.00	167075.87
Treatment	3	571747.00	190582.33
Error	40	7022976.00	175574.40

TABLE 80

ANALYSIS OF VARIANCE OF ADJUSTED RIB EYE AREA

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	23.70	1.58
Treatment	3	3.20	1.07
Error	40	20.50	0.51

TABLE 81

ANALYSIS OF VARIANCE OF PER CENT EMPTY G. I. TRACT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	721.90	27.21
Treatment	3	29.70	9.90
Error	40	692.20	17.31

TABLE 82

ANALYSIS OF VARIANCE OF PER CENT CAUL AND RUFFLE FAT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	721.90	27.21
Treatment	3	29.70	9.90
Error	40	692.20	17.31

TABLE 83

ANALYSIS OF VARIANCE OF PER CENT FILL

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	43	517.50	24.81
Treatment	3	38.50	12.83
Error	40	479.00	11.98

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This thesis was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of the committee. It was submitted to the Dean of the College of Agriculture and the Graduate Council and was approved as partial fulfillment of the requirements for the degree of Master of Science in Agriculture.

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